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The Fiscal Incidence of Some Experiments In Fiscal Federalism:

Technical Report

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THE FISCAL INCIDENCE OF SOME EXPERIMENTS IN FISCAL FEDERALISM:

TECHNICAL REPORT

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by

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Foreword

It cannot happen very frequently that two people are invited to work on a project that coincides almost perfectly with their professional interests. This study is the exception, however, and we feel fortunate indeed that this unique opportunity was offered to us. We began work on this project in the winter of 1976 and it has required the better part of two years to bring it to a conclusion. During that period we acquired an appreciation of how difficult it is to arrive at accurate answers to seemingly straightforward questions. Although the questions that are posed may be simple ones, we have concluded that the answers can never be. In fact, some readers of this study may be surprised at the lengths we were prepared to go to in our quest for answers.

In part, this problem stems from our belief that issues concerning the incidence of fiscal activity should be analyzed within a general equilibrium context, where as many repercussions as possible are taken into account. Data constraints, too, often retard the development of economic theory by hindering its application to economic issues. Moreover, there is the simple truth that economics remains an art as well as a science. While science may agree on what influences exist in correctly addressing a problem, choosing which of them to emphasize and which to relegate to minor status is by-and-large the domain of the artist. We shall wait to see if others will take our canvas and paint on it with different strokes or colors in the future. Meanwhile, we shall be content with our effort if, instead of providing clear-cut answers, it at least helps to sharpen and narrow the debate over the fiscal issues that were our concern.

A number of people provided assistance to this study. Foremost is James M. Dean of the University of Manitoba who should be given credit for the structure and the bulk of the content in Chapter 4. Without his insights in the area of benefit incidence, our study of fiscal incidence would have been seriously incomplete. Robert Anderson, formerly of Wayne State University and now with the General Accounting Office, offered extremely useful comments on the structure of our model. Our external consultant on this project, Charles E. McLure, Jr., at present with the National Bureau of Economic Research, offered detailed advice on every chapter and was responsible for keeping us from becoming sidetracked on many occasions and in good humor at all times. Peter Mieszkowski of the University of Houston and John Treddenick of the Royal Military College in Kingston acted as stern and able critics whose suggestions for improvement have been incorporated into our final draft.

From the Ministry of State for Urban Affairs we have relied upon, and been grateful for, the many-sided support offered by William Laycock and Barry Lacombe. The cooperation of the input-output division of Statistics Canada should also not go unrecognized. Many typists have struggled with our scratchy manuscripts and improved their appearance beyond what we had any reason to hope for. Two in particular, Kwan Wong and Rita Marsales, deserve special mention.

Chapter 1

An Introduction to the Issues and the Fiscal Experiments

One of the most significant trends in Canadian economic life over the last three decades has been the relatively rapid growth of the public sector. This brisk increase in the level of government expenditures and taxation reflects a persistent demand for a wide variety of publicly provided services, a strong commitment to a fully employed economy and a deeply rooted concern over the distribution of income and economic opportunity among Canadians. In this study, we focus on this last issue, — that is how various governmental tax and expenditure policies influence the distribution of incomes, or what is now commonly called the question of fiscal incidence. As will become apparent, answers to this question are not easily achieved. In this introductory chapter, we discuss the basic concepts of fiscal incidence, review the main body of empirical and theoretical literature on the subject, and indicate the scope and distinguishing features of our own attempt to wrestle with this important problem.

Research efforts in this particular area of public finance are of much more than academic interest. Given the considerable influence of the public sector on overall economic activity, any redirection of its tax or expenditure policies is bound to have an effect upon the distribution of income. Every time a new policy is introduced, or an old one is altered, some redistribution inevitably occurs. Governments cannot avoid redistributing income; they can only choose how it is to be done. If governments are to make intelligent choices among alternative tax and expenditure proposals, they require reliable information about the distributional implications of each alternative. Without such information, governments will find it difficult both to avoid activities which have unwanted distributive effects and to pursue instead alternative courses of action which would yield more desirable results. In brief, the purpose of studies of fiscal incidence is to provide the information needed significantly to narrow the gap between the intended effects of fiscal actions and those that may actually occur. If these efforts are successful, the path to hell need not be liberally paved with the good intentions of policy-makers, even if those of the incidence analyst are ignored. We will begin with a brief reference to the particular fiscal issues which are examined in this study.

1. Outline of the Fiscal Experiments

In a federalist union, some agreement must be reached on the proper division of tax and expenditure powers among the different tiers of government. Canada's fiscal evolution has witnessed a growing tendency for higher level governments to finance the rapidly increasing expenditures of lower level governments through a complex network of conditional and unconditional grants. Thus, at the present time, approximately one-fifth to one-quarter of federal expenditures consist of fiscal transfers to provincial governments, and an even larger fraction (about 40 per cent) of provincial revenue is transferred to municipal governments and hospitals in most jurisdictions. Our objective is to examine the distributional ramifications of an extended system of federal and provincial grants to municipal governments.

Our first set of experiments deals with the consequences of particular federal revenue-sharing programs. These programs envisage greater reliance on federal income taxes, both corporate and personal, to finance some combination of higher local government expenditures and reduced local authorities' dependence on the property tax. In every instance the enlarged federal grants are intended to apply to, and be adopted by, all the municipalities in Canada.

More precisely, we are interested in the effects of the following fiscal manoeuvres:

(a) Increases in the federal personal income tax to finance conditional grants for municipal expenditures on urban transit and social welfare payments.

(b) Increases in the federal corporate income tax for the same purpose as in (a) above.

(c) Increases in the federal corporate income tax and, alternatively, the personal income tax to finance a scheme of unconditional grants which would permit a proportional expansion of all municipal expenditures.

(d) Increases in the federal personal income tax to finance subsidies for the purchase of housing or land used in the construction of housing at the municipal level. As before, the target is all municipalities in Canada.

The preceding programs comprise a set of balanced budget fiscal experiments. In addition, we are interested in a set of differential incidence experiments in which local expenditures remain the same but their source of finance is altered:

(e) Replacement of a portion of the local residential property tax with revenues generated by a higher federal personal income tax.

(f) Replacement of a portion of the non-residential property tax with a higher yield from the federal corporate income tax.

Our second set of experiments is designed to reveal the distributional consequences of provincial revenue-sharing with all the municipalities that are located in a particular provincial jurisdiction. We repeat essentially the same set of experiments as in the case of federal revenue-sharing but with some small modifications. The housing and land subsidy experiments are not carried over to the provincial sphere, but everything else is, and for each of the federal tax instruments we merely substitute the corresponding provincial tax instrument. For example, in the first experiment above we change the provincial instead of the federal income tax rate. We also add one more experiment of a differential incidence nature. It consists of replacing a portion of the municipal residential and non-residential property tax with the extra revenue forthcoming from a higher rate for the provincial sales tax. We attempt to analyze the changes in income distribution in both the affected province and in the rest of Canada that would ensue from these new, and hypothetical, fiscal environments. As will become apparent, only limited and partial success was achieved with this second batch of experiments.

2. Essential Concepts and Measurement of Fiscal Incidence

There are three major avenues through which the actions of the public treasury mould or alter the distribution of income. These fall under the headings of tax, expenditure, and benefit incidence and will be discussed in turn. Studies of tax incidence seek to determine the ultimate resting place in the economy of the burden of some tax or tax increase. When governments impose taxes, real incomes decline because fewer resources are available for private use. However, the reduction in private real incomes may not be, and ordinarily is not, shared equally by all income groups. If the real incomes of each group were to fall proportionately, the incidence of taxation would be neutral in its impact on income distribution. Typically, the impact of taxation will be distributionally non-neutral and some groups will experience a larger drop in their real incomes than others. In fact, it is conceivable that some income groups will experience higher real incomes under some tax circumstances. Identifying who loses, who, if anyone, gains, and by how much, is the task of the tax incidence analyst.

The concept of tax incidence is closely related to the more familiar notion of tax shifting. The important idea behind "shifting" is that taxes may induce price changes in the economy which at least partially remove the tax burden on those for whom the tax is a statutory liability. For example, taxes imposed on the output of producers may be shifted forward to consumers in the form of higher prices or backward to owners of resources in the form of lower paymnets. However, these price changes may mirror only the initial adjustments to the tax and fail to indicate all of the subsequent price reactions that determine the ultimate resting place of the tax. Despite this inadequacy, the modern theory of tax incidence has incorporated the essential germ of the shifting model into its central core.[4]

As exemplified in Musgrave's seminal contributions to the theory of tax incidence, taxes affect people both as sellers of resources (capital, labor, or land) and as consumers of output. With the first effect, different people may gain or lose, depending on how taxation alters the prices they receive for the factors of production they own. This effect is called the sources of income determinant of tax incidence. In an analogous manner, different people may become better or worse off depending on how taxation produces changes in the prices they pay for their consumer purchases. This effect is called the users of income side of tax incidence since it refers to changes in the purchasing power of people's nominal or money incomes. Obviously, both the sources and uses side of income must be taken into account in deciding if the real income position of a particular income group is favourably or unfavourably affected by taxation. For example, the money incomes received by some group may increase (decrease) but this gain (loss) could be more than offset by the rise (fall) in prices they must pay for the specific bundle of goods contained in their consumption basket.

An important implication of this approach to tax incidence is that only changes in the structure of relative factor and product prices matter for the purpose of measuring distributive effects. If all prices in the economy were to change proportionately, the relative real income status of various groups would be undisturbed by the pattern of taxation. If all prices rose at the same percentage rate, any gains realized on the sources side of income would be cancelled by losses incurred on the uses side of income.

Whether they be of an empirical or theoretical nature, most studies of tax incidence typically employ a full employment assumption, and must be concerned, therefore, with the disposition of the tax revenues collected. Two alternative, hypothetical, dispositions are commonly employed: the revenues may be used to finance specific government expenditures or they may be used to replace other tax bases, in whole or in part. The first fiscal experiment is referred to as a balanced budget exercise in tax incidence, while the second setting, involving the substitution of one tax source for another, is called differential tax incidence analysis. So that the results of balanced budget analysis will not be contaminated by the particular way in which the government spends the tax funds, a stringent assumption is usually imposed on the pattern of government spending. This assumption requires that governments spend their revenues in exactly the same manner as private citizens would have if they had not been taxed. The force of this assumption is to pretend that there are no changes in expenditure patterns for the whole economy while tax changes are being made.

Since expenditures by government are kept fixed in a differential incidence setting, no assumption about the pattern of government spending is necessary in this case. Most empirical estimates of tax incidence compare estimates of the incidence of the existing system of taxes against a hypothetical proportional income tax that would yield the same revenue. They also invoke the assumption that every private spending unit has a common margin propensity to spend on all goods and services. Otherwise, expenditure shifts will accompany the redistribution effects of the tax change and must be accounted for in analyzing the incidence of taxes.

In fact, marginal expenditure patterns of governments are different from those of taxpayers. Consequently, relative prices will be altered by the redirection of spending arising from a particular expenditure tax package. When this occurs, the analysis of fiscal incidence must be extended to include the redistributive effect of differences between private and public expenditure patterns. This extension is the domain of expenditure incidence analysis, where, to ensure that the analysis of expenditure effects will not be sensitive to the method by which they are financed, the tax side of the government ledger is placed on a neutral footing. Thus expenditures of the government are assumed to be financed by a neutral tax such as a general consumption tax or a tax on all the employments of a particular fixed factor, both of which would leave relative prices unchanged. This tax assumption is the counterpart of the expenditure assumption of identical spending patterns made in a balanced budget analysis. It is evident, however, that a complete assessment of the redistributive impact of the budget must incorporate the analysis of both tax and expenditure incidence.

If this integration were achieved, however, it would still neglect an important facet of fiscal activity: the provision of government services to different groups in the economy. The welfare of individuals will depend on the extent to which they consume publicly provided services and on the value they place on the consumption of these services. While many public goods may be equally available to all groups in the economy, they are unlikely to be equally valuable to all of them. This last aspect of fiscal incidence is referred to as benefit incidence. A simple example will help to distinguish clearly benefit from expenditure incidence.[1] Suppose a local government decides to expand its provision of recreational park facilities, and finances these extra expenditures with additional proceeds from some neutral tax base. In the process of making these expenditures, the local government may bid some resources, such as land, away from the private sector in greater proportion than they will be released by the tax-diminished expenditures of the private sector. When there is full employment, the prices paid for these resources will rise, and the owners of these resources will enjoy a gain on the sources of income side. At the same time, other products produced by the same resources will undergo a rise in price and other groups will experience a loss on the uses of income side. These changes on both the sources and uses side constitute the expenditure incidence of this particular project. Once the park is constructed, however, its users will enjoy benefits. The distribution of these benefits across income groups is what is relevant for the study of benefit incidence. Since the bulk of these services are not commercially marketed, the challenge in this area of fiscal incidence is to obtain accurate measurements of what these services are worth to different income classes. It may be that for some groups certain services are a nuisance — for example, some groups who do not use the park facility may find their traffic and parking problems are enhanced by users of the facility. Significant capitalization of these effects into land values may also occur, with property values rising, for example, for residences in close proximity to the new park facility and declining elsewhere, as the relative attractiveness of different locations is changed by the presence of the park.

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[1] In tax incidence analysis, the benefits of government spending are ignored by assuming that they are neither complements to, nor substitutes for, privately supplied goods and services. Otherwise, private demand patterns would depend partly on the supply of public goods.

Needless to say, a complete study of fiscal incidence must take into account the totality of the effects that arise from the separate study of tax, expenditure and benefit incidence. By far the most difficult part of this task is the adequate determination of benefit incidence. Because the evaluation people place on the consumption of publicly provided services cannot be directly observed, indirect methods of imputation must be employed. These approximations cannot be, or at least, have not been, subjected to rigorous empirical testing.

The state of the economic art in this area can best be described as primitive; public finance economists are only now studying it seriously. An indication of this raw state of development is given by the existing literature, both empirical and theoretical, which fails to forge a satisfactory link between the consumption of publicly provided services, be they parks or national defence, and the pattern of private final demands. Virtually all empirical studies have viewed benefit incidence as a part of fiscal incidence that is purely additive to the analysis of tax and expenditure incidence. This state of affairs is grossly deficient on conceptual grounds since the supply of public goods properly belongs in the utility and demand functions of private citizens. Thus, for example, the increased provision of local police services would be expected to reduce the private demand for locks and security guards, while better road services no doubt would stimulate the demand for private automobiles. Because these interactions are complex and largely unknown in scope, they have so far been ignored. As will soon be seen, our own work follows in this tradition. We merely recognize that this is still an unresolved matter.

3. Earlier Analyses of Fiscal Incidence

Progress in the study of fiscal incidence has been directly related to the discovery of fresh theoretical insights in the analysis of various taxes and expenditures and to the development of new data which allow them to be tested. We shall now review and criticize some of the more significant works in the area of fiscal incidence without any pretence at being exhaustive.

Although there has been a long-standing interest in this subject, only recently has there been some serious attempts at empirical quantification for specific countries. Most of the pioneering work on the subject is the result of Gillespie's painstaking efforts.[2] He has carried out a comprehensive analysis of fiscal incidence in Canada and the United States, following the same format in both cases. On the tax side, he allocates tax payments for each tax source to different income groups according to well-established conventions about the shifting of the tax. Where there is some controversy about the ultimate resting place of the tax, the tax payments are allocated in line with alternative views, and the sensitivity of the overall results to alternative allocations is examined. For example, the corporate income tax may be assumed to be borne partially by corporate stockholders and partially by consumers, or it may be assumed to rest on owners of all types of capital.[3] The total amount of taxes estimated to be paid by each income group are subsequently expressed as effective tax rates for each group, using estimates of either broad income or adjusted broad income received by each group. The former income measure is an estimate of the income that would be received in the absence of all government activity, while the latter measure of income, including benefits from government expenditure, corresponds to income received in the presence of the government budget.

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[2] W. Irwin Gillespie, "Effect of Public Expenditures on the Distribution of Income", in Richard A. Musgrave (ed.), Essays in Fiscal Federalism, Washington: The Brookings Institution, 1965; The Incidence of Taxes and Public Expenditures in the Canadian Economy, Study of the Royal Commission on Taxation, No. 2, Ottawa, Queen's Printer, 1966: "The Redistribution of Income in Canada, 1969: An Analysis of the Incidence of Taxes and Public Expenditures in the Canadian Economy", mimeo, 1975.

In most previous studies expenditure incidence is either not discussed at all or is confused with benefit incidence. Typically, government spending is subdivided into: (a) specific expenditures, for which an identifiable group of beneficiaries can be discerned, and (b) general expenditures for which no single group obviously benefits more than others in the economy. Specific expenditures are allocated to income classes according to estimates of the use each class makes of the government service, on the assumption that total benefits can be adequately approximated by the costs of the program. For example, transfer payments are added to the income of transfer recipients, and expenditures on manpower programs are distributed according to the income position of those enrolled in the program. General expenditures, such as those for national defence or the system of jurisprudence, are alternatively allocated on the arbitrary bases of total population, total income, and total wealth. The first alternative lends a decidedly pro-poor bias to the allocation of benefits, while the second one is neutral among different income classes and the third is strongly pro-rich.

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[3] This latter alternative is suggested by the pathbreaking general equilibrium analysis of Arnold C. Harberger in his article, "The Incidence of the Corporation Income Tax", Journal of Political Economy, Vol. 70, No. 3, June 1962, pp. 215-40.

The upshot of Gillespie's entire exercise is the calculation of a fiscal residual for each income group which measures the difference between total benefits received and total taxes paid. Groups with a negative fiscal residual are net contributors to government activity, while those enjoying a positive fiscal residual are net beneficiaries whose real income is enhanced by government's budgetary choices. If a balanced budgetary position is assumed, thereby avoiding the difficult problem of how to treat deficits or surpluses, the sum of the fiscal residuals over all income classes adds to zero.[4] In concluding this part of the review, it may be mentioned that Gillespie's analysis on the tax side has been recently brought forward to 1969 in a study by Maslove, who also examines interprovincial variation in effective tax rates.[5]

The standard set by Gillespie for work in this area has been frequently imitated in studies of other countries, but seldom improved upon. Studies by Reynolds and Smolensky and the trio of Musgrave, Case and Leonard for the United States, Franzen, Lovgren and Rosenberg for Sweden, and Sahota for Brazil, represent examples of recent work cast in the Gillespie mould.[6] This work, including Gillespie's, indicates that governments have achieved some notable success in redistributing income, primarily from the expenditure rather than the tax side. In his most recent work, Gillespie has looked at changes in fiscal incidence over time.[7] For Canada between 1961 and 1969, he finds that there has been a redistribution from middle and upper-middle income groups to lower income groups and the richest five per cent. This is one of the first empirical refutations of "Director's Law": that middle income groups are net gainers from budgetary activities and gain at the expense of those who are at the very top and very bottom of the income scale.[8]

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[4] The appearance of government activity as a zero sum game, wherein some gain to the extent of others' losses, is a quirk of the methodology rather than a valid description of reality. In the first place, some costs, particularly the distorting or excess burden effects of taxation, are left out of account. More importantly, the substantial inframarginal benefits of many public services are given a zero valuation in this approach.

[5] Allan M. Maslove, The Pattern of Taxation in Canada, Ottawa: Economic Council of Canada, December 1972.

Further contradiction of this redistributive view is found in an application of the Gillespie methodology to the local government level by Greene, Neenan, and Scott,[9] for the suburban area of Maryland and Virginia around Washington, D.C. These authors discovered a U-shaped pattern of fiscal residuals with the lowest and highest income groups displaying the largest income gains. They explain this pattern as a rational fiscal choice on the part of local jurisdiction, who strive to retain members of the community with large tax-paying capacity and, at the same time, to meet the obvious needs of the poor.

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[6] M. Reynolds and E. Smolensky, "The Post Fisc Distribution: 1961 and 1970 Compared", National Tax Journal, December 1974; R. A. Musgrave, Karl E. Case and H. B. Leonard, "The Distribution of Fiscal Burdens and Benefits", Public Finance Quarterly, July 1974; T. K. Franzen, K. Lovgren and I. R. Rosenberg, "Redistributional Effects of Taxes and Public Expenditures in Sweden", Swedish Journal of Economics, March 1975; G. Sahota, Three Essays on the Brazilian Economy, Ministry of Finance, Rio de Janeiro, 1969.

[7] W. I. Gillespie, op. cit., 1975.

[8] For an exposition of this hypothesis concerning the profile of fiscal residuals, see G. J. Stigler, "Director's Law of Public Income Distribution", The Journal of Law and Economics, April 1970.

[9] K. V. Greene, W. B. Neenan and C. D. Scott, "Fiscal Incidence in the Washington Metropolitan Area", Land Economics, February 1976.

Three features of Gillespie's work and that of his followers deserve special comment. The fiscal comparison that is drawn by the Gillespie methodology is the difference between the situation which prevails with existing government activities and that which would be expected to occur were there no government sector at all. This measure of global incidence may be interesting from a philosophical point of view but it is certainly not the issue that is uppermost in the minds of policy-makers. They, presumably, are more interested in the effects of marginal changes in the budget than in the effects of removing all budgetary expenditures.

A more relevant exercise involves a comparison between the existing fiscal situation and that which would occur if a particular expenditure, or set of expenditures, were changed and financed by a specific set of tax adjustments. This limitation of the methodology is clearly recognized by Dodge in his simulation of the effects of recent changes in Canadian tax and transfer programs: "the only real use of such estimates of total incidence is to provide a yardstick against which to measure the effect on income distribution of changes in government tax and expenditure policy."[10] He also doubts the validity of the exercise:

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[10] David Dodge, "Impact of Tax, Transfer and Expenditure Policies of Government on the Distribution of Personal Incomes in Canada", The Review of Income and Wealth. Series 21, No. 1, March 1975.

"It is not possible to account for higher-order effects of all government activity since none of the behavioural parameters estimated from historical data could be expected to be stable in an environment from which the government sector is removed."[11] From his analysis of the 1972 tax and transfer policy changes, Dodge concludes that the revisions in budgetary policy acted to increase the extent of redistribution from rich to poor.

A further limitation of the Gillespie approach, hinted at by Dodge, is its assumption that the underlying or observed distribution of income is impervious to the introduction or removal of the entire government sector. This is tantamount to assuming a stable structure of net-of-tax factor and product prices and, for large budgetary changes, such assumed stability is unlikely. This point is stressed by Bird and De Wulf in their critique of tax incidence studies.[12] The problem encountered here is that the researcher can only observe and base his estimates of redistribution on the actual income distribution which is itself influenced by the existing pattern of taxes and expenditures. Any change in this existing pattern would probably alter the relative size of various income classes in some unknown direction.

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[11] David Dodge, ibid., p. 7.

[12] R. M. Bird and Luc De Wulf, "Taxation and Income Distribution in Latin America: A Critical Review of Empirical Studies", IMF Staff Papers, Vol. 20, No. 3, November 1973. Dodge, ibid., p. 7, also recognizes this deficiency when he speaks of the need to consider both direct (first-order) and indirect (higher-order) effects where the latter refer to relative price changes.

These comments all point to a final reservation about the global incidence approach used by Gillespie and others: it is not based on a rigorous model of economic behaviour showing how different groups in the economy react to a wide variety of tax and expenditure changes. Instead, resort to plausible but somewhat arbitrary rules of thumb is made in order to furnish some quantitative answers. To illustrate some of the pitfalls inherent in this procedure, consider the problem encountered in allocating indirect taxes. Invariably it is assumed that these taxes are shifted forward to consumers and are borne entirely on the uses side. But unless the indirect tax is perfectly general, and few such taxes of this nature are, sources of income side-effects are neglected. For example, a sales tax which did not apply to labor intensive service activities would most likely occasion a higher relative factor price for labor if the tax were to be increased. Moreover, the shifting conventions which may be appropriate in one set of economic circumstances may be inappropriate in another. For example, a new revisionist view of the property tax suggests that it may be borne in large part by all owners of capital.[13] However, this view is developed in the context of a closed economy and would be highly unsuitable if adopted as a method of distributing property taxes in an open economy that is subject to international capital flows, as Canada's is.[14]

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[13] Peter Mieszkowski, "The Property Tax: An Excise Tax or a Profit Tax?", Journal of Public Economics, Vol. 1, 1972.

[14] This doubt about the generality of the new view of the property tax finds lucid expression in Richard Bird, "The Incidence of the Property Tax: Old Wine in New Bottles?", Canadian Public Policy, Supplement II, (1976). For a discussion of this issue in a slightly different context, see Charles E. McLure, Jr., "The Relevance of the New View of the Incidence of the Property Tax", in Roy Bahl (ed.) Taxation of Urban Property in Developing Countries, Madison: University of Wisconsin Press, 1979.

Expenditure incidence is universally ignored because it cannot be adequately treated without a well-specified model of expenditure behaviour. As far as benefit incidence is concerned, only those crude impact measures are employed which reflect the rudimentary state of economic analysis in this area. Even plausible rules of thumb about benefit shifting, or the snatching of some gains by non-target groups, are ordinarily not available to the researcher, and negative side-effects are not usually considered. Attempts have been made, however, to allow for some types of benefit shifting in recent studies, although only in a very rough and *ad hoc* manner. For example, welfare transfers to the poor are being increasingly accepted as bestowing donor benefits on the rich because of general public concern to improve the economic conditions of the poor. Moreover, some apparent progress has been made in putting the treatment of general expenditures on a more satisfactory footing. Under certain rather restrictive assumptions, Aaron and McGuire have shown that an empirically based utility foundation may be used to distribute these expenditures across different income classes.[15] This is an important finding since the incidence researcher does not have the option of simply ignoring this part of the budget. If he were to try to do so, he would confront the intractable problem of determining which taxes he should also have to exclude from his analysis. Aaron and McGuire also show that, if total benefits are assumed to be equal to total expenditures, it is sufficient that public goods be optimally supplied and be produced under conditions of constant returns to scale. In an application of the Aaron-McGuire approach, Maital casts serious doubts on the validity of previous findings about the pattern of fiscal residuals.[16] His major conclusion is that budgetary policies in both the USA and Canada appear to produce negligible redistribution among income classes. In a subsequent chapter we shall return to a more detailed discussion of this matter and attempt to synthesize the different approaches found in the literature. We conclude this brief review by noting that the weak conceptual and theoretical underpinnings of most empirical studies have prompted one reviewer to reach the assessment that "the political and ethical importance of the issue has led authors to try the impossible in the hope of gaining some valuable information in the process."[17]

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[15] Henry Aaron and Martin C. McGuire, "Public Goods and Income Distribution", *Econometrica*, Vol. 38, No. 6, November 1970. See Chapter 4 for further discussion of this issue.

In the remainder of this chapter we set forth the distinguishing features of our approach to a study of fiscal incidence in Canada. We begin by noting that there seems to be a growing appreciation of the ability of general equilibrium models to generate answers for the consequences of tax and expenditure changes, that are much more satisfactory than those produced by alternative procedures which ignore the complex interactions between the private and public sectors. Partial equilibrium models that emphasize the shifting of taxes typically describe only a part of the overall adjustment process and thus offer an incomplete, and frequently misleading, picture of the way in which distribution is changed.

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[16] Shlomo Maital, "Apportionment of Public Goods Benefits to Individuals", Public Finance, Vol. 30, No. 3, November 1975.

[17] Luc De Wulf, "Fiscal Incidence Studies in Developing Countries: Survey and Critique", IMF Staff Papers, Vol. 22, No. 1, March 1975, p. 90.

The model we construct is a fairly elaborate, multi-sector, general equilibrium portrayal of the Canadian economy which we use to stimulate the impact of a variety of tax and expenditure changes. Our emphasis is therefore on marginal, rather than global, fiscal incidence as we attempt to analyze the distributive effects of specific fiscal policy changes. Our model is not the best that could conceivably be designed, and it is certainly not the last word on this matter, but we believe that it goes some distance towards filling the fiscal vacuum of which De Wulf spoke. Our construction is an extended and modified version of the Harberger model which incorporates both the essential open characteristics of the Canadian economy, its trade and capital market links with the rest of the world, and sufficient disaggregation to permit the consideration of tax and expenditure changes at all three levels of government.[18] Unlike in earlier studies, expenditure incidence, where it is relevant, is considered on a par with the question of tax incidence. We also allow, as has some of the earlier work, for the possibility that some Canadian taxes will be exported to, or borne by, either foreign consumers or taxpayers, or by foreign owners of capital employed in Canada. The exact nature of the model, its basic assumptions as well as its limitations, is spelled out in considerable detail in the succeeding chapter.

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[18] For an introduction to the workings of the Harberger model, see Charles E. McLure, Jr. and Wayne R. Thirsk, "A Simplified Exposition of the Harberger Model, I: Tax Incidence", National Tax Journal, Vol. 28, No. 1, March 1975. For a broad survey of the literature on the Harberger model, see Charles E. McLure, Jr., "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years", The Journal of Public Economics, Vol. 4, 1975.

In Chapter 3 we present our calculation of the parameter values needed to operate the model and discuss the data used to obtain these values. The biggest single weakness in our study of fiscal incidence lies in our treatment of benefit incidence. We can offer no quick or easy solutions to a satisfactory treatment of this problem but, rather, suspect that its resolution will require more emphasis on a detailed examination of particular expenditure programs instead of the more aggregated approach that has been pursued up to now. However, in Chapter 4, we present a synthesis of the alternative aggregative approaches that have appeared in the literature and relate them to each other in a consistent economic framework. In the same chapter, we consider how to measure benefit incidence for two specific expenditures areas, urban transit and welfare, as well as local government expenditures in general. In Chapters 5 and 6, we apply this methodology and present our major empirical results. These later chapters contain our main findings on the income redistribution effects that would accompany the various federal and provincial tax-sharing arrangements that are discussed. Chapter 7 provides a brief summary of our major results, a discussion of the limitations that surround them, and some thoughts on where future research might most profitably be directed.

CHAPTER 2

The General Equilibrium Model of Tax and Expenditure Incidence

Part I: The Structure of the General Equilibrium Model

In constructing a general equilibrium model we have been guided by three basic considerations. In the first place, the model should conform as closely as possible to the relevant dimensions of the Canadian economy. Second, it should avoid being so complex that its analysis becomes unwieldy. Finally, it must be of sufficient generality that it can examine a wide range of alternative fiscal situations. Not all of these objectives are mutually compatible; the last one, for example, obviously conflicts at some point with the second goal. Only by a judicious choice of assumptions can a reasonable compromise among these objectives be struck. We begin this chapter by describing the most important simplifying assumptions on which our analysis rests.

The model of household income distribution which we employ is of the comparative statics variety. It is static in the sense that the economy operates with a fixed endowment of domestically owned capital, labor and land, and dynamic adjustments are ignored. Our treatment of a variable stock of foreign-owned capital and the disposition of domestic savings is discussed later on. For the moment, it is sufficient to stress that we do not work with a dynamic growth model or in any way focus on the intertemporal adjustments to tax and expenditure changes which would occur during the transition from one long-run growth path to another.[1]

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[1] For models which analyze the long-run incidence and growth impact of tax policies, see Martin Feldstein, "Tax Incidence in a Growing Economy with Variable Factor Supply", The Quarterly Journal of Economics, Vol. 88, No. 4, November 1974, and the references therein.

To be more precise, we define an initial equilibrium position, permit certain taxes and expenditures to change, and then observe the final adjustments in production, resource employment and prices that follow in the wake of these fiscal changes. Our basic assumption is that these adjustments occur in response to the profit and utility maximizing goals pursued by producers and consumers respectively. These responses lead to a reshuffling of resources and outputs in the economy and typically establish a new pattern of relative factor and product prices in the post-tax and expenditure change equilibrium. Our measurement of these price changes forms the basis for our calculations of how household income is affected by particular fiscal changes.

We assume that the economy possesses adequate factor price flexibility to ensure the full employment of all resources. The other major macroeconomic issue, inflation, is also relegated to the background in our study. Our model contains no financial assets and, as such, is bereft of any mechanism which could establish a behavioral link between fiscal redistribution and changes in the overall price level. More significantly, the question of tax and expenditure incidence involves only changes in relative prices, and our measures of income redistribution are independent of whatever happens to the absolute price level.[2]

The analysis of fiscal incidence is particularly sensitive to the assumptions that are made concerning competitive-factor market behavior and the mobility of resources. For example, if an immobile factor is taxed in only one of its employments, it will simply bear the tax and there will be no further repercussions in the economy. If, however, the same resource were highly mobile, it would react to the tax by seeking employment in non-taxed activities until there was no further advantage from doing so. This mobility would spark a long chain of price adjustments that would have widespread repercussions on the whole economy. We employ a number of alternative factor mobility assumptions in our simulations of the model.

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[2] This point is demonstrated more formally by Charles E. McLure, Jr., "Tax Incidence, Macroeconomic Policy and Absolute Prices", The Quarterly Journal of Economics, Vol. 84, No. 2.

In product markets, we assume that producers behave as perfectly competitive profit-maximizers who cannot shift tax burdens forward in the short-run. While, admittedly, this is a strong assumption, the nature of the analysis and the type of adjustments made in response to fiscal change would not be much altered if, instead, we made the less restrictive assumption that producers strive to minimize their costs and possess a constant degree of product market monopoly.[3] For the sake of keeping the analysis tractable, we also abstract from the presence of non-fiscal distortions in the economy, in the form of tariffs, labor unions and the like.[4]

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[3] That is, our pricing equations assume that producers equate prices to marginal production costs. If imperfect competition could be described as the existence of a wedge between prices and marginal costs, and if the size of this wedge were fixed for each output, the form of our differential price equations would remain unchanged. Even if the mark-up were variable and responsive to tax changes, as long as producers strive to maximize profits, the results will be relatively insensitive to the presence of the mark-up. See Robert Anderson and J. Gregory Ballentine, "The Incidence and Excess Burden of a Profits Tax Under Imperfect Competition", Public Finance, Vol. 31, No. 2, 1976.

In the federal revenue-sharing experiments, we assume that domestically owned capital and labor are perfectly mobile among alternative geographic employments. Land, on the other hand, is assumed to be imperfectly mobile within a municipality between its two alternative uses, housing and agriculture. Unless one were interested only in short-run analysis, no other assumptions about the mobility of domestic capital and labor seem more appropriate.

When we turn to the provincial revenue-sharing experiments, where the fiscal changes occur within a single province, we retain the previous assumption about the mobility of land but permit labor and domestic capital to be less than perfectly mobile between the province and the rest of Canada. Within the province, however, both factors are assumed to be perfectly mobile. We have no way of knowing if these are the most realistic assumptions possible, but they strike us as being plausible and, as will be seen later, they are not without some empirical foundation. The following Table 2-1 helps to keep these cases straight.

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[4] Omitting these distortions will affect our ability accurately to measure the excess burden or real income losses of fiscal changes but should not damage our calculations of fiscal redistribution. For one thing, the more numerous are these distortions, the greater the likelihood that their effects will be offsetting. An assessment of the importance of omitted distortions in the analysis of unionization is found in J. G. Ballentine and W. R. Thirsk, "Labour Unions and Income Distribution Reconsidered", Canadian Journal of Economics, February 1977.

Table 2-1

Factor Mobility Assumptions

Situations	Domestic Capital	Labor	Land	Foreign Capital
Federal revenue-sharing	perfectly mobile	perfectly mobile	imperfectly mobile	imperfectly mobile
Provincial revenue-sharing	imperfectly (perfectly) mobile within Canada (a province)	imperfectly (perfectly) mobile within Canada (a province)	as above	as above

In both revenue-sharing models it is assumed that foreign-owned capital (direct foreign investment if you will) is imperfectly mobile between Canada and the rest of the world. While we rule out the possibility of national saving and investment increasing the capital stock in Canada, we do want to permit a stock adjustment possibility for the world supply of capital. This source of capital is such an important characteristic of the Canadian economy that it cannot be ignored. In effect, we assume foreign capital can be more quickly employed or disemployed in Canada than domestic saving can be converted into net capital formation. Large multinational companies, for example, can change relatively quickly the location in which they realize their previously made investment decisions. This facet of the model obviously imposes some strains on the consistency of our assumptions and compromises our desire to preserve a static model, but no other choice appears to us to be more attractive. Moreover, we ignore the international mobility of Canadian-owned capital since only a much more detailed model could explain adequately two-way capital flows in a competitive environment.

We assume also that all production processes can be characterized by a constant returns-to-scale production function. There is ample empirical support for this assumption in most activities. Each of the resources, capital, labor, and land, is treated as a single aggregate input into these production processes. This does not mean that we assume all units of capital, labor, and land are of uniform quality. Rather, we assume that these broad input categories contain components of varying quality and that the distribution of qualities within each category is fixed. With this interpretation we measure resource inputs in efficiency units so that a unit of input becomes the amount required to earn a dollar of factor income. While not wholly satisfactory, our treatment improves upon many earlier studies which did not distinguish fixed capital from land and, in fact, assumed that they were perfect substitutes in production.[5]

Turning to our formulation of consumer demand, we adopt the conventional view that commodity demands are a function of relative commodity prices and after-tax income. Consumers are classified according to the income group to which they belong; we assume that these income groups display dissimilar, marginal propensities to consume the various commodities, although each group has, we assume, a uniform and constant, compensated, price elasticity of demand.[6] For our fiscal experiments we rely on a particular form of consumer utility function which implies separability in demand. Separability means that consumers' satisfaction from using one commodity is independent of their consumption of all other commodities, including that supplied by government. This is not an unreasonable postulate in view of the large consumption aggregates with which we will be working, and it allows us to define a consistent and non-arbitrary set of own-and cross-price elasticities from a reliable knowledge of income elasticities and one other parameter. An additional advantage is that many empirical studies of consumer demand, in Canada and elsewhere, have used the same approach.[7]

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[5] See, for example, A. C. Harberger, "The Incidence of the Corporate Income Tax", Journal of Political Economy, June 1962.

[6] If the information were available, we could easily relax this last assumption by taking an appropriate, weighted average of the variable price elasticities.

Finally, we have had to confront the thorny issue of how best to treat the presence of net saving in the data we employ. Because of its static nature, our model is consistent with a positive amount of gross, but not net, saving. To ignore savings would require us also to ignore the incomes earned in the domestic production of capital goods. The result would be a less than general model. Our compromise is to adopt a Keynesian position and view net savings as the act of purchasing capital goods (i.e., a component of corporate goods output, as we shall see later) and assume that insufficient time elapses in the model to install the purchased capital goods in the economy's production processes.

This treatment of net savings also allows us to skirt another methodological difficulty, that of defining a balanced government budget when our data indicate an overall budgetary surplus. In our model we simply view this surplus as another source of net saving and, therefore, consider the government budget to be in balance, with total expenditures matching total revenue. Of course, the surplus, in effect, merely enables more resources to be available to meet the demands of private investors for additional capital.

In a similar vein, we impose the requirement of a balanced international payments position on the economy. No economy can sustain an external disequilibrium for very long and it is clearly incompatible with the concept of a general equilibrium. This payments constraint is almost the same thing as balanced commodity trade, but differs from it in that we allow some of the after-tax earnings of foreign capital to be repatriated through the foreign exchange market.

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[7] See Appendix C for a discussion of these studies. A useful exposition of this approach is found in R. Frisch, "A Complete Scheme for Computing All Direct and Cross Demand Elasticities in a Model with Many Sectors", Econometrica, April 1959.

A critical issue in any model involves the most suitable choice of sectors or commodities and the level of aggregation associated with them. We have partitioned the economy into sectors producing finally demanded commodities purchased by the public and private sectors. The distinguishing feature of privately purchased items is their treatment under corporate income and property tax legislation. Here we depart from tradition, but for good reason we believe. Previous studies have customarily segregated the economy into taxed and untaxed sectors.[8] For example, in the analysis of the incidence of the corporate income tax, the economy is split into a part producing corporate output and another part producing non-corporate output, both of which sell a variety of the same or different goods to consumers or other producers. This procedure involves splitting at least some industries apart -- for example, allocating a fraction of retail trade to each of the two sectors, a procedure which does not make good sense for a number of reasons. It first of all obscures consumers' choices since it is almost impossible to relate their observed purchases to this definition of output. It, therefore, becomes exceedingly difficult to select reasonable parameter values for the price elasticities that are based on established empirical studies of consumer demand.[9] As a related point, the available data on consumer expenditures bear no resemblance to this division of outputs in the economy, with the effect that it becomes extremely difficult to cope with the uses side of fiscal incidence in an empirical study. This may partially explain Harberger's virtual neglect of the uses side. A second major defect of this approach is that it permits the corporate part of an industry to incur a tax-induced price increase relative to its non-corporate part without explaining how both parts, presumably selling the same goods and services, can continue to coexist in a competitive atmosphere. However, for some sectors, such as agriculture, this poses no problem since it is almost wholly organized in the non-corporate form.

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[8] For example, see A. C. Harberger, op. cit.

We have sought to circumvent some of these conundrums by working with a group of vertically integrated, but differentially taxed, final goods. Each aggregate commodity we define combines the outputs or value-added of different industries. Thus, our procedure for defining output adds different industry divisions instead of segregating each division according to its tax treatment, as has been done in the past. This step helps to achieve both greater consistency on the uses side and less uncertainty in selecting demand parameters. By working through the input-output table, in a manner more fully described in the next chapter, we are able to define each final aggregate commodity as the sum of value-added emanating from each of the various one-digit industries in the economy. Although our model does not include intermediate commodity demand explicitly, it can be reconciled with the presence of these demands if it is assumed that there is either no, or an equal degree of, substitutability between primary factors (capital, labor, and land) and intermediate inputs.[10] By invoking these assumptions, we insure that intermediate inputs are separable from the use of primary factors and are enabled to speak unambiguously of a production function for each aggregate commodity defined in terms of value-added and in which only primary factors of production enter as arguments.

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[9] This problem is apparent in the reaction of Shoven and Whalley to Harberger's choice of values for price elasticity. They reject his assessment but arbitrarily select a value of unity, the value chosen by many economists when all else fails. See J. B. Shoven and J. Whalley, "A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the U.S.," Journal of Public Economics, Vol. 1, 1972.

We define each aggregate, final commodity according to the special tax treatment it receives or according to its role as an object of government expenditure. Because of its light taxation under the corporation income tax and its status as a subsidy recipient in our experiments, we distinguish a housing sector which supplies housing services. Similarly, an urban transit system is included as an object of local government demand. Other activities relatively lightly touched by the corporate income tax are commercial services and final food products, or agriculturally based consumption activities. In our model both of these are represented as distinct final goods. As well, we have a vector of other local government expenditures excluding urban transit. Goods more heavily taxed under the corporate income tax are aggregated to form a composite corporate good. Finally, we establish two types of foreign-demanded goods or exports. For one kind, it is assumed that foreign demand is perfectly elastic at the going world price in domestic currency. The other type represents exports in which Canada is an important supplier on the world market and has some degree of monopoly power in the sense that additional (reduced) supplies would lower (raise) the world or international price for the product. In contrast to the former, this latter type is dominated by the corporate mode of organization. Receipts from both types of exports are used to pay for imports of final goods and the services of foreign-owned capital goods.

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[10] Although we do not use explicit functional forms for our production relationships, this assumption is consistent with a constant elasticity of substitution (CES) production function which includes intermediate inputs as a separate production factor. The separability implied by this functional form is a normal requirement for consistent aggregation.

Imports are a heterogeneous aggregate considered to be an imperfect substitute in demand for all types of domestic output. This assumption allows us to view the price of imports as a separate argument in the demand function for each of our final, domestically produced, goods, rather than treating imports as the sum of the gaps between domestic demand and domestic supply in which are perfect substitutes for domestic outputs. The advantage of this formulation is that it allows us logically to define broad sectors containing both importable and exportable kinds of output. Otherwise, it is anomalous to have a competitive model which incorporates two-way industry trade flows. For example, some agricultural commodities are exported while others, like oranges, are imported. Commercial transport and housing services we take to be nontradeable domestic output, along with government supplied services. Our corporate good is a conglomerate of nontradeable, importable and exportable output, examples of which are cement, textiles, and paper products, respectively. Products of the automobile industry are further illustrations of corporate sector components which produce both exportable and importable outputs as a result of intra-industry specialization.

If the data had been more amenable, we would have chosen to work with a domestic output sector comprising exportables instead of exports since it would then have been possible to make the supply of exports depend on domestic as well as foreign-demand conditions. Just as imports are not equal to domestic excess demands, exports are not equivalent to domestic excess supplies, which implies that exports are not perfect substitutes in production for domestically consumed output. Shifts in domestic demand, therefore, have no direct effects on the supply of exports, although indirect effects, working through cost changes, are possible. Because we do not have a category of exportables, export prices do not appear in the domestic demand functions. It should also be pointed out that the aggregate final commodities we have defined above differ almost as much in their sales and property tax treatment as in the extent to which they are exposed to the corporate income tax. More precise definitions of these final goods are given in the following chapter.

Since we conduct two basic kinds of fiscal experiments -- federal and provincial revenue-sharing, and with each of these we make slightly different assumptions concerning factor mobility -- it is not surprising that two variants of the same structural model are required. To consolidate most of the previous discussion, it will be helpful to introduce some nomenclature and carefully distinguish between the variants of our model. Let the following capital letters denote the production and consumption of our final goods:

H = level of housing services produced and consumed in Canada
T = level of urban transit services produced and sold in Canada
Z = level of commercial services produced and sold in Canada
C = amount of corporate final goods produced and consumed in Canada
A = amount of final foodstuffs produced and sold in Canada
E = domestic production and foreign consumption of flexibly priced exports
F = domestic production and foreign consumption of fixed-price exports
M = foreign production and domestic consumption of imports
G = government production of nonmarketable local public services.

In the federal tax-sharing variant the private sector in Canada produces the outputs H, Z, C, A, E and F, the public sector produces T and G, while residents of Canada consume all domestic outputs, except E and F, plus foreign goods M. In the provincial revenue-sharing model we divide Canada into two regions, the province and the rest of Canada, and consider the interactions of these regions with each other and with the rest of the world. Each province produces some of H, T, C and A, and possibly some of E and/or F, depending on the particular province, while each region consumes all domestic outputs, except exports of E and

F, and, in addition, some imports M from the rest of the world. Interregional trade takes place only in the commodity C, since A, H, T, G and Z are products locally produced and locally consumed in each region.[11] Thus, regions in Canada are imperfectly specialized in the production of corporate (C) goods. We also require that regional trade be balanced, in so far as exports from a region to the rest of Canada and foreign countries must match the sum of imports from these two areas plus payments to foreign (non-Canadian) capital owners. While it is reasonable to assume that owners of labor reside in the region where they are employed, this last assumption imposes the same restriction on Canadian owners of capital and land. Thus, total expenditure by residents in any region is necessarily equal to the income produced by that region, net of foreign capital payments. This assumption could be relaxed if information on the interregional ownership of capital were available, but such is not the case.

If we let K, N and L denote the use of capital, labor and land respectively, we can depict the assumed structure of factor use in domestic production with the aid of the table below (where an "x" denotes factor usage):

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[11] We recognize that some commercial services can be, and often are, found in interregional trade but data constraints force us to overlook this possibility. The same is true for A goods. As explained later on, the presence of a larger number of interregionally traded goods tends to constrain severely the flexibility of the model and limit its range of results.

Table 2-2

Employment of Domestic Resources

Factor/Output	H	T	Z	C	A	E	F	G
K	x	x	x	x	x	x	x	x
N	x	x	x	x	x	x	x	x
L	x	-	-	-	x	-	x	-

Factor use in urban transit may require some further comment. By urban transit we really mean municipal bus services which use the services of labor and capital plus those of the existing network of roads. For this reason, land is treated as a fixed factor in the production of urban transit services. Land does appear in the production of F, however, since we consider some land-using agricultural commodities to have a fixed world price.

A corporate tax rate, t_c, applies at varying rates to the capital employed in the production of all domestic outputs. The rate varies according to the ratio of corporate to total capital used in the production of the final goods. A property tax on improvements, t_k, strikes the use of capital in the production of all privately produced outputs -- government use of capital in the production of G and T is exempted -- while a property tax on land, t_L, is imposed on land used in the production of H, A, and F.[12] An indirect commodity tax, with an ad valorem rate, t_s, is imposed at differential rates on all privately produced, domestic outputs and imports. Finally, a potential ad valorem subsidy, S, is attached to the purchase of housing and urban transit services, as well as to the purchase of land used in housing. This is almost a complete description of the tax and subsidy instruments that enter into the model. Later on we will introduce two additional fiscal instruments of a direct or personal nature, the individual income tax and government transfer payments.

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[12] The property tax, as it affects owner-occupied housing, has frequently been viewed as an excise tax on housing services. This is a sensible approach only if the income share of untaxed labor is negligible and if the tax rate applied to land and improvements is the same. For owner-occupied housing, these conditions may be met, but, generally speaking, it is more accurate to view the tax as a partial factor tax.

The structure of our model has more than a passing resemblance to the interregional tax-incidence model developed by McLure.[13] Like him, we assume labor to be interregionally (here, internationally) immobile, while capital is not. The same mechanisms, permitting tax burdens to be shifted between jurisdictions, appear in both models. Private demands are not influenced by the supply of public goods and the assumptions of full employment and perfect competition are explicitly made. The model we deal with merely adds some extra layers of complexity to this basic framework. In contrast to the McLure model, we consider a world with initial taxes, add several home or non-tradeable goods to the model, and analyze a situation with three factors of production and three interacting economies instead of just two. However, we give short shrift to the external world economy since we do not consider all of the possible adjustments which may take place there in response to Canadian fiscal policy changes. We assume these adjustments in production and consumption in the rest of the world are inconsequential for Canada, since its economy is but a tiny fraction of the worldwide economy. A more ambitious project might consider a complete specification of demand and production for the economies of Canada's major trading partners. Finally, we make some concessions to the existence of intermediate commodity demands and net saving in applying the model, and permit imperfect specialization in the pattern of interregional trade.

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[13] Charles E. McLure, Jr., "The Inter-Regional Incidence of General Regional Taxes", Public Finance, Vol. 24, 1969.

Before turning to the equations of our model, we should make explicit a few of the hidden assumptions it contains. The corporate income tax is a tax on the use of equity capital by incorporated business. Our equations assume that an increase in the size of the corporate income tax will alter neither the decision of firms about whether or not to incorporate nor the debt-equity ratios of corporate enterprises.[14] In the case of the property tax we assume it applies to assets of roughly equal lifetime, for, otherwise, longer-lived assets will face a heavier tax burden than assets with a shorter lifetime.[15]

We begin with the equations of the federal tax-sharing variant of our model since it is more compact and easier to manage. We rely on the previous nomenclature referring to outputs, taxes and subsidies and introduce the following new notation to describe the model (subscripts generally refer to factors or output, while superscripts apply to different regions or, in the case of land, to outputs F, A or H):

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[14] The issue here is whether the marginal cost of capital moves in proportion with capital's average cost. We assume proportionality but for a different view, see Joseph E. Stiglitz, "Taxation, Corporate Financial Policy, and the Cost of Capital", Journal of Public Economics, Vol. 2, 1973.

[15] We treat the tax as a tax on capital income when in fact it is applied to capital values. If asset lives vary, a given percentage change in the tax on capital values burdens capital incomes at different rates.

L - total amount of land in economy

N - total amount of labor in the economy

I - total national income gross of taxes or inclusive of government sector income

K_f - foreign-owned capital

K_n - domestically owned capital

P_i - net or after-tax price of i^{th} factor or output. This is either the price received by a factor, e.g., P_k in the case of capital, after payment of corporate income and property taxes (but before personal income taxes), or the net revenue received by a producer, e.g., P_c, after payment of indirect commodity taxes.

P^*_i - gross of tax or subsidy price of the i^{th} output or factor. For outputs, $P^*_i = P_i (1 + t_s)$ or $P^*_i = P_i (1 - S)$. Since property taxes are deductible under the corporate income tax, the relationship between the gross and net price of capital is $P_k = P^*_k (1 + t_c) (1 + t_k)$ while that for land is $P^*_L = P_L (1 + t_L)$.

e - the international exchange rate (units of domestic labor to foreign currency)[16]

P_M - constant world price for imports, expressed in foreign currency.

P_F - constant world price for fixed-price exports, expressed in foreign currency.

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[16] The exchange rate is a relative price between tradeable and non-tradeable items. Since we adopt the price of labor as our numeraire, the exchange rate in our model becomes the number of units of labor (a nontraded "good") that can be exchanged for a unit of foreign currency (or imports).

The subscript "d" refers to demand; for example, C_d is the demand for corporate final goods. A subscript K, L or N attached to an output refers to the marginal physical product of that factor in the production of some output; for example H_k is the marginal physical product of capital in the production of housing services. Finally, rather than superscript all the different product tax and subsidy rates, it is to be understood that they are effective rates which are non-uniform across different commodities. All of the equations which follow are written in implicit functional forms.

A. Production (Supply) and Factor Demand Equations

(1) $H = H(K_H, N_H, L_H)$

(2) $P_K (1 + t_K) = P_H H_K$

(3) $P^H_L (1 + t_L) = P_H H_L$

(4) $P_N = P_H H_N$

(5) $T = T(K_T, N_T)$

(6) $P_K = P_T T_K$

(7) $P_N = P_T T_N$

(8) $C = C(K_c, N_c)$

(9) $P_K (1 + t_c)(1 + t_K) = P_c C_K$

(10) $P_N = P_c C_N$

(11) $Z = Z(K_Z, N_Z)$

(12) $P_K (1 + t_c)(1 + t_K) = P_Z Z_K$

(13) $P_N = P_Z Z_N$

(14) $A = A\ (K_A,\ N_A,\ L_A)$

(15) $P_K\ (1 + t_c)\ (1 + t_k) = P_A A_K$

(16) $P_N = P_A A_N$

(17) $P^A{}_L\ (1 + t_L) = P_A A_L$

(18) $E = E\ (K_E,\ N_E)$

(19) $P_K\ (1 + t_c)\ (1 + t_k) = P_E E_K$

(20) $P_N = P_E E_N$

(21) $F = F\ (K_F,\ N_F,\ L_F)$

(22) $P_K\ (1 + t_c)\ (1 + t_k) = P_F F_K$

(23) $P_N = P_F F_N$

(24) $P^A{}_L\ (1 + t_L) = P_F F_L$

(25) $G = G\ (K_G,\ N_G)$

(26) $P_K = P_G G_K$

(27) $P_N = P_G G_N$

(28) $P_M = e\bar{P}_M$

B. Product Demand Equations

(29) $H_d = H_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(30) $T_d = T_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(31) $Z_d = Z_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(32) $C_d = C_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(33) $M_d = M_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(34) $A_d = A_d\ (P^*{}_c,\ P^*{}_A,\ P^*{}_Z,\ P_T,\ P^*{}_H,\ P^*{}_M,\ I,\ G)$

(35) $P_E/e = f\ (E)$

(36) $P_F = e\bar{P}_F$

(37) $P_G G = \beta\cdot$(total tax revenue)

C. Balance of Payments Equilibrium

(38) $P_E E + P_F F = P_M M + P_K K_f$

D. Factor Supply and Total Income (GNP) Relationships

(39) $K_f = K_f\,(P^*_{kc})$ where P^*_{kc} is the gross return to corporate sector capital

(40) $L_H/(L_A + L_F) = g\,(P^H_L / P^A_L)$

(41) $\bar{L} = L_H + L_A + L_F$

(42) $\bar{N} = N_A + N_F + N_Z + N_E + N_T + N_G + N_C + N_H = \sum_i^S N_i$

(43) $K = \bar{K}_n + K_f$

(44) $K = K_A + K_F + K_Z + K_E + K_T + K_G + K_C + K_H = \sum_i^S K_i$

(45) $I = \sum_i^S K_i P^*_K + \sum_i^S N_i P_N + P^{A^*}_L (L_A + L_F) + P^{H^*}_L L_H + B_s - K_f P_K$ where

$B_s = t_s P_M M + t_s P_c C + t_s P_Z Z + t_s P_A A + t_s P_H H$, the total of sales tax receipts

(46) $I = P^*_H H + P^*_c C + P_T T + P^*_Z Z + P_G G + P^*_M M + P^*_A A$

(47) $P_N = 1$

The specification of at least some of these equations requires further comment. In Part A we have the production function for each final output and the factor demands for each resource used in the production process. Each producer of final output minimizes his costs of production by using every factor up to the point where its gross price, or marginal cost, is equal to its marginal return net of any sales tax. In equations (26) and (27) we assume that the suppliers of local public output are also cost-minimizers. Since government services are not marketed, the best interpretation to place on the price P_G is that it represents either the shadow price of public output or the unit cost of government production. The last equation (28) indicates imports are provided in perfectly elastic supply at the going world price.

In Part B, the demand for domestically produced and consumed final output depends on the gross (inclusive of sales tax) prices of all of these outputs plus the level of gross national income I and, for the sake of formal completeness, the level of publicly provided output G.[17] We ignore this latter argument in our empirical calculations. Equation (35) makes the world price of flexibly priced (E) exports depend on the level of exports, while the next equation (36) posits a perfectly elastic foreign demand for fixed price exports at the given world price. Note that since E and F represent exports rather than exportables, P_E and P_F do not appear directly in the demand functions for domestic output. Finally, equation (37) indicates that expenditures on local public services are a positive fraction β of total tax revenue.

Equation (38) is the balance of payments constraint expressed in terms of domestic currency, with the price of imports written net of sales tax so that the market for foreign exchange is also in equilibrium. For want of a more appealing alternative, we assume that all of the after-tax earnings of foreign capital are repatriated and that any reinvestment of this income is a separate decision. This payments constraint holds, as we have written, it only after all adjustments to fiscal changes have been completed. During the transition from one equilibrium to another, foreign capital flows will, of course, alter the level of foreign exchange receipts as the stock of foreign-owned capital is adjusted to a new level.

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[17] Changes in the supply of at least some public sector outputs will ordinarily shift the demands for privately produced outputs, depending upon whether the outputs are either substitutes or complements. We ignore these shifts as well as public services of an intermediate nature so that G does not appear as an argument in the production functions.

Postulating the most suitable specification of these foreign capital flows is not an easy task. The rationale behind equation (39) is as follows. Canada has negotiated reciprocal, double-taxation treaties with most capital exporting countries; these treaties permit foreign companies operating in Canada to credit Canadian corporate income and withholding tax liabilities against other tax obligations incurred in the home country. Two different tax situations can be distinguished, one of them applicable to branch plants and the other to subsidiaries incorporated in Canada. Branches and their parents are considered by the home country to be single entities subject to taxation on their joint profits. Credits for foreign income and withholding taxes are allowed up to the limit of the home country's tax liability on foreign-earned income. For example, if the Canadian corporate income tax rate is less than the U.S. rate, an increase in the Canadian rate will increase Canada's share of the return earned by U.S.-owned capital. This gain, however, will not be at the expense of the foreign company but rather at the expense of the foreign treasury which permits the company to claim a credit for the additional tax levied by Canada. If Canada's rates were higher than the U.S. rates initially, an even higher Canadian rate would give rise to excess credits but no refunds from the foreign treasury. Nonetheless, if the overall tax credit limitation is elected, these excess credits are transferable and can be applied against income earned in other countries having a rate of taxation less than the U.S. rate. In addition, any excess credits can be carried forward for five years and backward for two years.

In Canada, at least, the more prevalent form of foreign business organization is the incorporated subsidiary which, in addition to crediting, enjoys the advantage of deferral under U.S. tax law. Deferral permits the subsidiary to defer taxes in the home country until the time when profits are repatriated. These firms will be attracted to countries having a relatively low rate of corporate income tax. On the other hand, for both types of business organization, property taxes are ineligible for credit. However, they do qualify as a deduction.

Although strictly true only if incorporated firms repatriate fully, it seems sensible, as a first approximation, to make the level of foreign capital employed in Canada a function of the gross, rather than net, return to capital in the corporate goods sector. Assuming that the Canadian corporate rate remains below the U.S. rate, the higher the gross return realized by a foreign firm, the larger will be its after-tax profits when account is taken of the device for crediting. Since our model contains a variety of gross rates of return, the rate achieved in the corporate goods sector was selected as the most relevant to foreign investment since very little foreign capital can be found in the unincorporated goods or services sectors. This notion of sector-specific capital flows has already received some attention in the discussion of how multinational corporations operate.[18]

There is probably no other assumption in the model as crucial as this one about the tax sensitivity of foreign investment. Consider, for example, an alternative scenario in which the supply of capital to the Canadian economy is highly responsible to the after-tax return to capital. If this net return were fixed by investment opportunities in the rest of the world, it would be impossible for Canadian taxes to burden the incomes of capitalists. A higher rate of corporate income tax, for example, would merely raise the gross return and cost of capital in Canada along with the prices of nontradeable commodities. Tradeable goods, whose prices are anchored in world markets, would adjust by paying lower returns to internationally immobile labor and land. In this way, a tax imposed on capital income would be borne by the owners of factors of production other than capital.

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[18] See, for example, R. E. Caves, "International Corporations: The Industrial Economics of Foreign Investment", Economica, February 1971. Caves discusses some of the implications of a model in which international capital flows serve to equate the return to capital in the same (corporate) sector in different countries but not between sectors in the same country.

Since direct investment is a close substitute for export sales, it could be argued that the exchange rate should also determine the level of foreign investment. This is a refinement in specification which we did not explore.

Note also, that since foreign-owned capital may be largely exempted from domestic tax changes, double-taxation treaties act to restrict the impact of the tax to domestic capitalists, ignoring the treasury transfer effect.

Our view of Canada's connections to the international capital market would ordain a far different outcome than the one suggested above. We would expect the volume of foreign investment to be unaffected if the net return to capital in Canada were diminished and, indeed, to increase if the net return fell by less than the amount that the tax on capital incomes was raised. A possible weakness in our approach is that it appears to confine Canadian owners of capital to investment opportunities that are available in only the domestic market. If the net return to Canadian-owned capital were reduced by taxation, we would expect at least some of these owners to adjust by attempting to employ their capital in other areas of the world. Under these circumstances, foreign-owned capital may flow into the country at the same time that domestically owned capital departs. In our competitive setting, there is no simple method of modelling capital flows which may go in both directions. Our basic assumption, embodied in equation (43), is that in terms of the absolute size of response, the foreign-controlled capital flow dominates any offsetting adjustment by Canadian capitalists. A possible justification for this treatment, although one that does not deserve too much emphasis, is that the tax changes which we examine are small enough to make it unlikely that Canadian investors would suddenly find it worthwhile to overcome various capital market "frictions" in the form, for example, of imperfect information and the risk of exchange rate adjustments.

In equation (40), as in equation (24), land is assumed to be perfectly mobile between agricultural pursuits A and F but imperfectly mobile between these uses and the housing sector. Land is allocated between the two sectors in response to differences in the net or after-tax prices received by landowners. The form of this equation implies that some agriculture is carried on within the boundaries of at least some predominantly urban municipalities in Canada. In equation (45) we define gross national income as gross domestic product (GDP) less the net-of-tax income payments received by foreign capitalists. Gross national income includes the sum of after-tax income of domestic resource owners and the government's income from tax revenue. Equation (46) is the economy's budget constraint equating gross national income to gross national expenditure. Finally, equation (47) reflects our choice of the price of labor to serve as the numeraire for our system so that all price changes occur with respect to this particular price.

We now count equations and variables to make sure we have a determinate system of equations. Although we have 47 equations, only 45 of them are independent. Given the overall budget constraints, any one of the demand equations is redundant. Equations (45) and (46) together imply that equation (38) also holds. To see this dependence, note, for example, that $P_N N_E + P^*_K K_E = P_E E$ and that similar equations hold for other outputs besides E. Thus, we may rewrite equation (45) as (44)

$$I = P_E E + P_F F + P_G G + P^*_H H + P^*_c C + P_T T + P^*_Z Z + P^*_A A + t_s P_M M - K_f P_K$$

Inserting this result into equation (46) and cancelling like terms on both sides of the derived equation yields the result that $P_E E + P_F F = P_M M + K_f P_K$, or the balance of payments constraint in equation (38).

The model also contains forty-five endogenous variables, thirty quantity variables, H, K_H, L_H, N_H, T, K_T, N_T, C, K_c, N_c, Z, K_Z, N_Z, A, K_A, L_A, N_A, E, K_E, N_E, F, G, K_F, N_F, L_F, M, K, K_f, K_G and N_G as well as fifteen price and income variables, P_K, P_N, $P^H{}_L$, $P^A{}_L$, P_H, P_Z, P_C, P_Z, P_E, P_F, P_G, P_M, P_T, e and I.

In the expression for gross national income, no clear distinction between private and public sector income receipts is made in order to avoid unwarranted notational complexity. We will do it here, however, so that we may bring out more clearly the flavor of our fiscal experiments. For the federal revenue-sharing experiments, we work with a consolidated federal and municipal government account involving local government expenditures or subsidies and a combination of federal and municipal tax instruments. If we let B_X and B_P denote federal personal tax payments and federal transfer payments respectively, and recall that B_s stands for sales tax receipts as in equation (45), we can write this consolidated government budget in the following algebraic form:

$$\text{(a)} \quad \sum_i t_k (1 + t_c) P_k K_i + \sum_i t_c P_k K_i + t_L P_L^H L_H + t_L P_L^A (L_A + L_F) + B_s + B_X = P_G G + S_L P_L^H L_H + S_H P_H H + S_T P_T T + B_P.$$

This equation states that the sum of property taxes on land and capital, corporate income taxes, sales taxes and federal personal income taxes are devoted to expenditures on local public services (G), transfer payments and subsidies to purchases of housing, of land used in housing, and urban transit. Of course, governments have other tax instruments at their disposal, (e.g., excises) and make other types of expenditure. But these are not relevant to our experiments, which are concerned with the specific tax, or tax and expenditure, changes contained in the preceding budget statement. Private disposable income, and expenditures out of this income, can be expressed as:

$$\text{(b)} \quad \sum_i K_i P_K + \Sigma N_i P_N + L_H P_L^H + (L_A + L_F) P_L^A$$
$$-K_{fPK} - (B_X - B_P) = P_Z (1 + t_s) Z +$$
$$P_c (1 + t_s) C + P_M (1 + t_s) M +$$
$$P_A (1 + t_s) A + P_T (1 - S_T) T + P_H (1 - S_H) H$$

where the outputs are those purchased by the private sector.

If we were to add both private and public budget constraints, we would have a statement which says that after-tax private incomes plus net government revenue (the sum of all taxes less subsidies and transfer payments) is equal to the value of purchases at producers' prices plus indirect taxes less subsidies, or simply that gross national income equals gross national expenditure. Since personal income taxes or transfers are paid or received on the basis of size of income rather than type of income, their proper treatment requires that we recast the budget equations in terms of the size distribution of income. This conversion appears in our system of differential equations which are used to solve for the effects of various fiscal changes and to which we now turn.

Part II: The Differential Equations

If we had explicit, functional forms, for all of the equations embedded in the system (1)-(47), we could attempt to obtain an iterative solution to our various experiments.[19] However, since the exact form of many of these functions is unknown, we instead resort to the simpler procedure of differentiating our implicit functions to give us a system of differential equations which are linear approximations of the explicit functions. The full differentiation of the system is a tedious exercise with which we will not bore the reader. Here we illustrate the form of our differential equations and present the reduced set of equations needed for a solution. But first, some additional notation is needed. The "hat" symbol ^ is used to denote the percentage change in a given price or quantity variable and the following parameters are introduced:

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[19] This is the approach taken by Shoven and Whalley, op. cit., who work with production of utility functions which exhibit constant elasticities of substitution. Shoven, in a recent paper, suggests that the approximation we use may be a reasonably accurate one. See J. B. Shoven, "The Incidence and Efficiency Effects of Taxes on Income from Capital", Journal of Political Economy, December 1976.

ε_{ij} = the compensated price elasticity of demand for the i'th commodity, with respect to a change in the j'th commodity price, assumed to be the same for all income groups.

θ_{ij} = the value or cost share of the i'th factor of production used in the production of the j'th output. $\sum_{i=1}^{n} \theta_{ij} = 1 \; \forall j$.

σ_{ij}^{k} = the partial elasticity of factor substitution between the i'th and j'th factors used in the production of the k'th output. An unsubscripted value, σ^{k}, is used for those outputs employing only the two factors of capital and labor in production.

η = price elasticity of foreign demand for flexibily priced exports .

γK = elasticity of the stock of foreign capital employed in Canada with respect to the gross return to capital in the corporate sector.

γL = elasticity of the relative supply of land in housing, as opposed to agriculture, with respect to relative net prices for land.

V_i = a ubiquitous value term denoting the product of price and quantity for factors and commodities. For example, $V_k = P_k K$ and $V_c = P_c C$ while $V^*_K = P^*_k K$ and $V^*_c = P^*_c C$.

h_i = income elasticity of demand for the i'th output, assumed to be constant for all income groups.

$\hat{J}_i$ = the income effect in the uncompensated demand function for the i'th output (the percentage change in demand for the i'th output attributable to real income changes). Since this variable is a part of the demand functions for different income classes, we leave its exact formulation until later when we incorporate the size distribution of income into the analysis.

α^i_j = fraction of income of the j'th income group spent on the i'th output.

Some of these parameters cannot be freely chosen since there are certain theoretical restrictions on the values they may take. Thus, homogeneity conditions for product and factor demands require that $\sum_j \epsilon_{ij} = 0$ and $\sum_j \theta_j \sigma_{ij} = 0$ and our assumption of constant returns to scale in production requires that $\sum_i \theta_{ij} = 1$. Likewise, the budget constraints imposes the condition $\sum_{i=1} \theta_i h_i = 1$ for each income class. Note here that assuming constancy for h_i is equivalent to assuming a variable marginal propensity to consume the i'th output if the average propensity to consume varies by income class.

Consider first the housing sector in our model. Differentiation of equations (1)-(4) gives us five relationships for the housing sector, three factor demand changes, one supply change and an equation linking changes in the price of housing services to gross factor price changes. These equations have the following form:[20]

$$(c)\quad \hat{L}_H = \sigma^H_{LL}\,\hat{P}^H_L + \sigma^H_{KL}\,\hat{P}_K + \sigma^H_{LN}\,P_N + \hat{H}$$

$$(d)\quad \hat{K}_H = \sigma^H_{KL}\,\hat{P}_L^H + \sigma^H_{KK}\,\hat{P}_K + \sigma^H_{KN}\,\hat{P}_N + \hat{H}$$

$$(e)\quad \hat{N}_H = \sigma^H_{LN}\,\hat{P}_L^H + \sigma^H_{NK}\,\hat{P}_K + \sigma^H_{NN}\,\hat{P}_N + \hat{H}$$

$$(f)\quad \hat{H} = \theta_{KH}\,\hat{K}_H + \theta_{NH}\,\hat{N}_H + \theta_{LH}\,\hat{L}_H$$

$$(g)\quad \hat{P}_H = \theta_{KH}\,\hat{P}_K + \theta_{NH}\,\hat{P}_N + \theta_{LH}\,\hat{P}_L^H$$

We can use any combination of three of the first four equations above since the fourth is implied by the other three. In the fifth equation (g), we express $\hat{P}_H$ as a weighted average of factor price changes. Differentiation of equations (5)-(27) will yield a similar set of relationships for the other commodities in our system.

Now consider the demand for housing services contained in equation (29). If we differentiate it, we have the percentage change in the demand for housing services which appears as:

$$(h)\quad \hat{H}_d = \epsilon_{HH}\,\hat{P}^*_H + \epsilon_{Hc}\,\hat{P}_c^* + \epsilon_{HA}\,\hat{P}_A^* + \epsilon_{HZ}\,\hat{P}_Z^* + \epsilon_{HT}\,\hat{P}_T + \epsilon_{HM}\,\hat{P}^*_M + \hat{J}_H$$

$= \sum_{i=1}^{6} \epsilon_{Hi}\,\hat{P}_i + \hat{J}_H$ where J_H is the percentage change in demand for H due to the change in real income of consumers.

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[20] Though not explicitly denoted, in order to conserve on notation, all of the factor price changes in (c) to (g) are gross factor price changes.

As with $\hat{P}_H$, each product price change can be expressed as a factor share weighted average of gross factor price changes, having the form:

$$\hat{P}_i = \theta_{Ki} \, (\hat{P}_K + \widehat{(1 + t_K)} + \widehat{(1 + t_c)}) + \theta_{Ni} \, \hat{P}_N + \theta_{Li} \, (\hat{P}_L + \widehat{(1 + t_L)} \,)$$

In equilibrium, changes in the demand for housing services must be equal to the percentage change in the supply of these services. Combining equations (f) and (h) and the product price relationship we obtain:

$$\text{(i)} \quad \theta_{KH} \, \hat{K}_H + \theta_{LH} \, \hat{L}_H + \theta_{NH} \, \hat{N}_H = \Sigma_{i=1} \, \{ \, \varepsilon_{Hi} \, \{ \, \theta_{Ki} \, (\hat{P}_K + \widehat{(1 + t_K)} + \widehat{(1 + t_c)} \,) + \theta_{Li} \, (\hat{P}_L^{\,H} + \widehat{(1 + t_L)} \,) + \theta_{Ni} \, \hat{P}_N + \widehat{(1 + t_s)} + \hat{P}_M \, \} \, \} + \hat{J}_H = \sum_{i=1}^{6} \varepsilon_{hi} \, \hat{Y} + \hat{J}_h$$

Equations of a similar sort will appear for other outputs in our system. Note that from equation (28) we can also substitute $\hat{e}$ for $\hat{P}_m$. In the factor markets we combine equations (c) to (e) and the relationship $\Sigma_j \theta_j \, \sigma_{ij} = 0$ to generate:

$$\text{(j)} \quad \hat{K}_H - \hat{L}_H = \theta_{LH} \, (\sigma_{LK}^{\;H} - \sigma_{LL}^{\;H}) \, (\hat{P}_L^{\,H} + \widehat{(1 + t_L)} \,) + \theta_{KH} \, (\sigma_{KK}^{\;H} - \sigma_{KL}^{\;H}) \, (\hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)} \,) + \theta_{NH} \, (\sigma_{NK}^{\;H} - \sigma_{NL}^{\;H}) \, \hat{P}_N \text{ and}$$

$$\text{(k)} \quad \hat{K}_H - \hat{N}_H = \theta_{LH} \, (\sigma_{LK}^{\;H} - \sigma_{LN}^{\;H}) \, (\, \hat{P}_L^{\,H} + \widehat{(1 + t_L)} \,) + \theta_{KH} \, (\sigma_{KK}^{\;H} - \sigma_{KN}^{\;H}) \, (\, \hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_k)} \,) + \theta_{NH} \, (\sigma_{NK}^{\;H} - \sigma_{NN}^{\;H}) \, \hat{P}_N$$

Factor demands for other outputs will display a similar form. Without further comment we present the complete set of differential equations. To conserve on space, we denote the expression in the interior { }-shaped bracket of equation (i) above as $\hat{Y}$, since it is common to all of the demand functions for output.

We begin with the equilibrium requirements for output, proceed to factor demands and supplies, and end with the balance of payments, the numeraire and the income effect.

I $\theta_{KH}\hat{K}_H + \theta_{NH}\hat{N}_H + \theta_{LH}\hat{L}_H = \sum_{i=1}^{6} \varepsilon_{Hi} (\hat{Y}) + \hat{J}_H$

II $\theta_{KT}\hat{K}_T + \theta_{NT}\hat{N}_T = \sum_{i=1}^{6} \varepsilon_{Ti} (\hat{Y}) + \hat{J}_T$

III $\theta_{KZ}\hat{K}_Z + \theta_{NZ}\hat{N}_Z = \sum_{i=1}^{6} \varepsilon_{Ti} (\hat{Y}) + \hat{J}_Z$

IV $\theta_{Kc}\hat{K}_c + \theta_{Nc}N_c = \sum_{i=1}^{6} \varepsilon_{ci} (\hat{Y}) + \hat{J}_c$

V $\theta_{KE}\hat{K}_E + \theta_{NE}\hat{N}_E = \eta (\theta_{KE} (\hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)}) + \theta_{NE} \hat{P}_N - \hat{e})$

VI $\theta_{KA}\hat{K}_A + \theta_{NA}\hat{N}_A + \theta_{LA}\hat{L}_A = \Sigma^{6} \varepsilon_{Ai} (\hat{Y}) + \hat{J}_A$

VII $\hat{e} = (\theta_{KF} (P_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)})$

$+ \theta_{NF}\hat{P}_N + \theta_{LF} (\hat{P}_L^{A} + \widehat{(1 + t_L)})$

VIII $\theta_{KG}\hat{K}_G - \theta_{NG}\hat{N}_G = \hat{T}_x - \theta_{KG}\hat{P}_K - \theta_{NG}\hat{P}_N$

IX $\hat{K}_H - \hat{L}_H = \theta_{LH} (\sigma_{LK}^{H} - \sigma_{LL}^{H}) (\hat{P}_L^{H} + \widehat{(1 + t_L)})$

$+ \theta_{KH} (\sigma_{KK}^{H} - \sigma_{KL}^{H}) (\hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)}$

$+ \theta_{NH} (\sigma_{NK}^{H} - \sigma_{NL}^{H}) \hat{P}_N$

X $\hat{K}_H - \hat{N}_H = \theta_{LH} (\sigma_{LK}^{H} - \sigma_{LN}^{H}) (\hat{P}_L^{H} + \widehat{(1 + t_L)})$

$+ \theta_{KH} (\sigma_{KK}^{H} - \sigma_{KN}^{H}) (\hat{P}_K + \widehat{(1 + t_L)} + \widehat{(1 + t_K)})$

$+ \theta_{NH} (\sigma_{NK}^{H} - \sigma_{NN}^{H}) \hat{P}_N$

XI $\hat{K}_T - \hat{N}_T = \sigma^{T} (\hat{P}_K - \hat{P}_N)$

XII $K_Z - \hat{N}_Z = \sigma^{Z} (\hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)} - \hat{P}_N)$

XIII $\hat{K}_c - \hat{N}_c = \sigma^{c} (P_K + \widehat{(1 + t_c)} + \widehat{(1 + t_K)} - \hat{P}_N)$

XIV $\hat{K}_E - \hat{N}_E = \sigma^E (\hat{P}_K + \widehat{(1+t_K)} + \widehat{(1+t_L)} - \hat{P}_N)$

XV $\hat{K}_A - \hat{L}_A = \theta_{LA} (\sigma^A_{LK} - \sigma^A_{LL}) (\hat{P}^A_L + \widehat{(1+t_L)})$

$+ \theta_{KA} (\sigma^A_{KK} - \sigma^A_{KL}) (\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)})$

$+ \theta_{NA} (\sigma^A_{NK} - \sigma^A_{NL}) \hat{P}_N$

XVI $\hat{K}_A - \hat{N}_A = \theta_{LA} (\sigma^A_{LK} - \sigma^A_{LN}) (\hat{P}^A_L + \widehat{(1+t_L)})$

$+ \theta_{KA} (\sigma^A_{KK} - \sigma^A_{KN}) (\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)})$

$+ \theta_{NA} (\sigma^A_{NK} - \sigma^A_{NN}) \hat{P}_N$

XVII $\hat{K}_F - \hat{L}_F = \theta_{LF} (\sigma^F_{LK} - \sigma^F_{LL}) (\hat{P}^A_L + \widehat{(1+t_L)})$

$+ \theta_{KF} (\sigma^F_{KK} - \sigma^F_{KL}) (\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)})$

$+ \theta_{NF} (\sigma^F_{NK} - \sigma^F_{NL}) \hat{P}_N$

XVIII $\hat{K}_F - \hat{N}_F = \theta_{LF} (\sigma^F_{LK} - \sigma^F_{LN}) (\hat{P}^A_L + \widehat{(1+t_L)})$

$+ \theta_{KF} (\sigma^F_{KK} - \sigma^F_{KN}) (\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)})$

$+ \theta_{NF} (\sigma^F_{NK} - \sigma^F_{NN}) \hat{P}_N$

XIX $\hat{K}_G - \hat{N}_G = \sigma^G (\hat{P}_K - \hat{P}_N)$

XX $\sum_{i=1}^{8} (\frac{Ki}{K}) \hat{K}_i = (\frac{Kf}{K}) \gamma_K (\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)})$

XXI $\hat{L}_H - (\frac{L_F}{L_F + L_A}) \hat{L}_F - (\frac{L_A}{L_A + L_F}) \hat{L}_A = \gamma_L (\hat{P}^H_L - \hat{P}^A_L)$

XXII $\sum_{i=1}^{3} L_i \hat{L}_i = 0$

XXIII $V_F (\theta_{KF}\hat{K}_F + \theta_{NF}\hat{N}_F + \theta_{LF}\hat{L}_F) + (V_F - V_M) \hat{e}$

$+ V_E \{ (n+1) (\theta_{KE}(\hat{P}_K + \widehat{(1+t_c)} + \widehat{(1+t_K)}) + \theta_{NE}\hat{P}) - n\hat{e} \}$

$= V_M (\sum_{i=1}^{6} \epsilon_{Mi} (\hat{Y}) + \hat{J}_M) + V_{K_f} (\sum_{i=1}^{8} (\frac{K_i}{K}) \hat{K}_i + \hat{P}_K)$

$$\text{XXIV} \quad \hat{P}_N = 0$$

$$\text{XXV} \quad \hat{J}^j_i = h_i \; \{ \; \hat{I}_j - \sum_{i=1}^{6} \alpha^i_j \; (\; \theta \; Ki \; (\; \hat{P}_K + (1 \hat{+} t_c) + (1 \hat{+} t_K) + \theta_{\;Li} \; (\; \hat{P}_L{}^j + (1 \hat{+} t_L) \;) + \theta_{Ni} \hat{P}_N + (1 \hat{+} t_s)) \; \}$$

These equations probably need no further comment in light of what has already been said, except perhaps to point out that equation XX depicts the international mobility of foreign capital as a function of the gross return to corporate capital and that equation XXV captures, for a particular income class, the j'th, the influence of real income changes on commodity demands (and may be more readily recognized if it is written as $h_i \; (\hat{I}_j - \overset{6}{\Sigma} \alpha^i_j \; \hat{P}^*{}_i)$. In addition, in equation VII the expression $\hat{T}_x$ is used to denote the exogenous change in government's tax revenue.

From these equations we can determine the reaction of twenty-five variables to a variety of tax and expenditure changes. There are nineteen quantity variables, K_H, L_H, N_H, K_T, N_T, K_Z, N_Z, K_C, N_C, K_E, N_E, K_F, N_F, L_F, K_A, L_A, N_A, K_G and N_G, and six price and income variables, P_K, P_N, $P^H{}_L$, $P^A{}_L$, e and J. The short-hand variable $\hat{Y}$ also involves a combination of these same variables. If equations VII and XXV for $\hat{e}$ and $\hat{J}_i$ are substituted into the remaining equations, the dimensions of our model reduce to a 23-by-23 system. If we let D denote a matrix of the model's structure of production, demand and mobility coefficients, Q be a vector of 23 endogenous variables and U represent a matrix of exogenous tax and expenditure instruments, the system could be compactly written to appear as $D \cdot Q = U$ and solved in the form of $Q = D^{-1}U$. This is the format used to obtain computer simulations of the various experiments.

Part III: Personal Taxes and Transfers and the Measurement of Tax Incidence

We next consider the conversion of our model to incorporate the size distribution of income, and personal income taxes and transfers, and then discuss the manner in which the solutions to the models are used to measure the national and international incidence of Canadian tax and expenditure changes. For the first purpose we assume there are n different income classes and let the shares of the total amount of domestic capital, labor and land owned by the j'th income class be ϕ_j, λ_j, and π_j, respectively. By definition, $\sum_j \phi_j = \sum_j \lambda_j = \sum_j \pi_j = 1$. The after-tax and transfer income received by members of the j'th income class then becomes $\phi_j V_K + \lambda_j V_N + \pi_j (F_L^F + V_L^A) - B_x{}^j + B_P{}^j$ (where V_K, V_N, and V_L are the values of total capital, labor and land income respectively). In the operation of the model, the only changes introduced by the conversion to a size distribution of income is in the formulation of our demand functions. Consider a typical demand function, that for housing services which previously appeared as $\hat{H}_d = \sum_{i=1}^{8} (\varepsilon_{Hi} \hat{P}_i) + \hat{J}_H$. With different income classes appearing in the model, the income effect $\hat{J}_H$ is transformed into $\hat{J}_H = \sum_{j=1}^{n} (\frac{Hj}{H}) \hat{J}_h^j$ or, as $\hat{J}_H = \sum_{j=1}^{n} (\frac{Hj}{H}) h_H$

$$\{\varphi_j' \hat{P}_k + \lambda_j' \hat{P}_N + \pi_j' \hat{P}_L - (\frac{B_x^j}{I_j}) \hat{B}_x^j + (\frac{B_P^j}{I_j}) \hat{B}_P^j - \sum_{i=1}^{6} \alpha_j^i (\hat{P}_i^*) \}$$ where

$\varphi_j' = \varphi_j V_k / I_j$, is the share of capital income in the total disposable income received by the j'th income class and λ_j' and π_j' are similarly defined income shares for labor and land.[21] The ratios $(B^j{}_x/I_j)$ and

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[21] To simplify the notation, P_L here denotes the weighted average of the percentage change in land prices occurring in housing and agriculture.

(B^j_p/I_j) are, respectively, the amounts of personal taxes paid and transfers received as a fraction of disposable income. The sum of the income shares (including transfers) and the sum of the expenditure shares both add to unity. Income terms in the other demand functions for output undergo a transformation similar to the one shown above for housing.

This expression for a typical income effect is a convenient one since it relates directly to our earlier terminology of tax and expenditure incidence. Consider first the initial set of terms in the expression for the income effect which appear as:

$$\varphi'_j \hat{P}_k + \lambda'_j \hat{P}_N + \pi'_j \hat{P}_L - \left(\frac{B^i_x}{I_j}\right) \hat{B}^j_x + \left(\frac{B^j_P}{I_j}\right) \hat{B}^j_P$$

Together, these terms measure the percentage change in the nominal after-tax income (I_j) of the j'th income class. We referred to this earlier as the sources side of tax incidence. Given information on factor shares by income class, along with data on taxes and transfers by income group, we can determine incidence on the sources side of income once we have obtained a solution from the model for the change in factor prices. Next, consider the collection of terms $\sum_{i=1}^{6} \alpha^j_i (P^*_i)$ from the expression for the income effect. This group of terms is a weighted average of the product price changes where the weights are the consumption shares of a particular income group. It, therefore, measures the change in purchasing power of that group's nominal income and is equivalent to the variation in the cost of living index for that group.[22]

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[22] That is, the summation shown here measures the change in income required to enable a member of the j'th income class to consume his original consumption bundle whenever prices are allowed to vary.

We previously identified this variation as incidence on the uses side of income. It too can be calculated from the solution to the model, given data on consumption patterns by income class. Together, the effects on both the uses and sources side of income determine the change in real income experienced by a particular income class. By comparing these real income effects for all of the different income classes, we arrive at the national incidence of any given tax or expenditure change.

We can make this comparison most elegantly by examining how any group fares relative to the rest of the economy. If we let θ_K, θ_N, and θ_L denote factor shares for the whole economy, and θ^i represent purchases of the i'th commodity by all income classes, as a fraction of total disposable income, we can estimate the extent of income redistribution among different income classes as the difference between $\hat{J}_j$ and $\sum_{J=1}^{n} \hat{J}_j \left(\frac{I_j}{I}\right)$. If changes in personal taxes and transfers are set equal to zero, because they are policy instruments, this difference can be written as:

$$(\phi_j - \theta_K)\,\hat{P}_K + (\lambda_j - \theta_N)\,\hat{P}_N + (\pi_j - \theta_L)\,\hat{P}_L - \sum_{i=1}^{6} (\alpha_j^i - \theta^i)\,(\,\hat{P}_i + \widehat{(1 + t_s)}\,)$$

or, since $\phi_j + \lambda_j + \pi_j = \psi$ (the net tax rate for the j'th group) and $\theta_K + \theta_N + \theta_L = \Omega$ (the average net tax rate) as $(\phi_j - \theta_K)\,(\hat{P}_K - \hat{P}_L)$ $+ (\lambda_j - \theta_N)\,(\hat{P}_N - \hat{P}_L) + (\Psi - \Omega)\,\hat{P}_L - \sum^{6} (\alpha_j^i - \theta^i)\,(\,\hat{P}_i + \widehat{(1 + t_s)}\,)$.

Net tax rates are defined as personal taxes less transfers over the value of disposable income.

This formulation of the incidence issue brings out, in sharp focus, the conclusion that the degree of income redistribution depends directly on the manner in which tax and expenditure changes alter the structure of relative factor and produce prices and on the extent to which factor ownership and consumption patterns vary among different income groups. A redistribution of income is impossible unless relative factor and product prices change and there is, in addition, some variability in factor ownership and consumption patterns across different income groups.

We have yet to determine, however, how any given tax burden will be partitioned into a share borne by foreigners and a share borne by Canadian citizens. That foreigners may shoulder a portion of Canadian taxes introduces the phenomenon of tax exporting. Canadian tax exporting is the same thing as the international incidence of Canadian taxes or the spillover effects of Canadian taxes on residents of foreign countries. Some algebraic manipulation of the equations in our model permits us to see quite clearly the channels for tax exporting that it contains.

If R represents real national income, I is gross national income and $V_i = P_i X_i$, where X_i denotes one of the outputs either produced or consumed in the model, the standard measurement for the percentage change in real income is given by $\hat{R} = \sum_{i=1}^{8} V_i \hat{X}_i$ or, equivalently, as $\hat{R} = \hat{I} - \sum_{i}^{6} \alpha_i \hat{P}_i^*$.[23]

By analogy to the previous discussion, this expression for $\hat{R}$ can be intepreted as the income effect for the whole economy. If Canada is able to export tax burdens to foreigners, she will enjoy a positive income effect at the expense of other nationalities. But real income may change for reasons other than the possibility of tax exporting. To see this, begin with the usual definition of I:

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[23] For a lengthier explanation of this measurement basis for income changes, see Charles E. McLure, Jr. and Wayne R. Thirsk, op. cit. and McLure, 1975, op. cit.

$$I = \sum_{i=1}^{8} K_i\,(1 + t_K)\,(1 + t_c)\,P_K + \sum_{i=1}^{8} N_i P_N + L_H P_L{}^H + (L_A + L_F)\,P_L{}^A$$

$$(1 + t_L) - K_f P_K + \sum_{i=1}^{4} V_t{}^i - \sum_{i=1}^{2} V_s{}^i$$

where $\sum_{i=1}^{4} V_t{}^i$ is the sum of sales tax payments, $\sum_{i=1}^{4} V_t{}^i = \sum_{i=1}^{4} t_s\,V_i$, $i = C, A, Z, M$ and $\sum_{i=1}^{2} V_s{}^i$ is the sum of ad-valorem subsidies, $\sum_{i=1}^{2} V_s{}^i = \sum_{i=1}^{2} S_i\,V_i$ where $i = H, T$ in this case.

Totally differentiating I yields the result:

$$dI = \sum_{i}^{8} V_K{}^i\,\hat{K} + \sum_{i}^{6} V_K{}^i\,(\widehat{1 + t_K}) + \sum_{i}^{6} V_K{}^i\,(\widehat{1 + t_c}) + \sum_{i}^{8} V_K{}^i\,\hat{P}_K + \sum_{i}^{8} V_N{}^i\,\hat{P}_N$$

$$+ V^H{}_L\,(\widehat{1 + t_L}) + V_L^H\,\hat{P}_L^H + V_L^H\,\hat{L}_H + (V_L^A + V_L^F)\,(\widehat{1 + t_L}) + V_L^A\,\hat{L}_A + V_L^F\,\hat{L}_F$$

$$+ (V_L^A + V_L^F)\,\hat{P}_L^A - V_{Kf}\,\hat{P}_K - V_{Kf}\,\hat{K}_f + \sum_{i}^{4} V_t^i\,(\hat{t}_s + \hat{P}_i + \hat{X}_i)$$

$$- \sum_{i}^{2} V_s^i\,(\hat{S}_i + \hat{P}_i + \hat{X}_i).$$

To simplify the expression for dI note that, in the case of capital, $\sum_{i}^{8} V_K^i\,\hat{K}$ may be rewritten as the sum $(P_K \Sigma\,\hat{K} + ((\,t_K\ (1 + t_c) - t_c)$ $P_K \Sigma K_i)\ \hat{K}$, and the first term as $V_{Kf}\hat{K}_f$ since $\hat{K} = \frac{\Sigma dK_i}{\Sigma K_i} = (\frac{K_f}{K})\ \hat{K}_f$. The last term in this sum captures the excess burden of the corporate income and property taxes on capital income which we will denote as K^B.[24] In the case of land, we may use the constraint on total land supply,

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[24] Excess burden, to repeat, measures the loss in real income that results from the distorting effects of the capital taxes on the allocation of capital. As long as the capital taxes are not uniform across final commodities, the term K^B will be nonzero. This formulation of the issue, however, rests on the assumption of complete factor mobility. There would be no excess burden if resources were completely immobile.

$L_H\hat{L}_H + L_A\hat{L}_A + L_F\hat{L}_F = 0$ to transform the sum $V_L^H \hat{L}_H + V_L^A \hat{L}_A + V_L^F \hat{L}_F$ into the equivalent expression $(L_A \hat{L}_A + L_F \hat{L}_F)\,(P_L^A\,(1 + t_L) - P_L^H\,(1 + t_L))$.[25] This expression measures the excess burden of land reallocation between housing and agriculture which we will subsequently denote as L^B. A final simplification makes use of the general relationship between product and factor price changes:

$$\hat{P}_i V_i = V_K^i\,(\hat{P}_K + \widehat{(1 + t_c)} + \widehat{(1 + t_L)}) + V_N^i \hat{P}_N + V_L^i\,(\hat{P}_L + \widehat{(1 + t_L)}).$$

Making these substitutions, the expression for dI simplifies to:

$$dI = \hat{P}_E V_E + \hat{P}_F V_F + \hat{P}_c V_c + \hat{P}_Z V_Z + \hat{P}_G V_G + \hat{P}_T V_T + \hat{P}_A V_A + \hat{P}_H V_H - \hat{P}_K V_{Kf}$$
$$+ \sum^4 V_t^i\,(\hat{t}_s + \hat{P}_i + \hat{X}_i) - \sum^2 V_s^i\,(\hat{S}_i + \hat{P}_i + \hat{X}_i) + K^B + L^B.$$

Expanding the expression for the change in real national income, we get:

$$dR = dI - V_G\hat{P}_G - V_M^*\,(\hat{P}_M + \widehat{(1 + t_s)}) - V_c^*\,(\hat{P}_c + \widehat{(1 + t_s)})$$
$$- V_Z^*\,(\hat{P}_Z + \widehat{(1 + t_s)}) - V_A^*\,(\hat{P}_A + \widehat{(1 + t_s)}) - V_H^*\,(\hat{P}_H + \widehat{(1 - S_H)})$$
$$- V_T^*\,(\hat{P}_T + \widehat{(1 - S_T)})$$

Substituting into dR the preceding expansion for dI, and cancelling where possible, gives us our final result for the change in real national income:

$$dR = (V_E\hat{P}_E + V_F\hat{P}_F - V_M\hat{P}_M - V_{Kf}\hat{P}_K) + \{ K^B + L^B + \sum_i^4 V_t^i\,(\hat{X}_i) - \sum_i^2 V_s^i\,(\hat{X}_i) \}.$$

The last collection of four terms in large brackets measures the excess burden of the distorting effects which may arise from nonuniform

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[25] If a subsidy is attached to the purchase of land used in housing, this expression is modified so that it appears as

$$(L_A\hat{L}_A + L_F\hat{L}_F)\,(P_L^A\,(1 + t_L) - P_L^H\,(1 + t_L)\,(1 - S_L)).$$

taxes or subsidies imposed on capital, land and, as shown by the last two terms, commodities. Nonuniform taxes or subsidies on products cause discrepancies between the value that consumers and producers place on another unit of production and, thus, provoke a nonoptimal allocation of resources.

The first four terms in large brackets, however, indicate the two major avenues of tax-exporting contained in our model. Real incomes of Canadians will increase if fiscal changes induce either an improvement in Canada's international terms of trade (if the export prices, P_F or P_E, or both, rise relative to the price of imports, P_M) or, alternatively, if a lower after-tax price of capital reduces the incomes received by foreign capital owners. If, for example, Canada faces a less than perfectly elastic supply of either capital or imports, there may be some benefit from using fiscal means to restrict the demand for foreign capital and foreign goods (at least to some degree, but never totally). Furthermore, if the world demand for Canadian exports is less than perfectly elastic, Canada may gain by reducing the supply it offers and exploiting its monopoly power.[26]

If world commodity prices and the net price of capital were to change proportionately, there would be, on the other hand, no international spillovers from Canadian fiscal changes. This can be formally seen if we let $\hat{P}_E = \hat{P}_F = \hat{P}_M = \hat{P}$ and substitute this common price change variable into the relevant portion of the expression for dR. In this situation our formula for tax or fiscal exporting collapses to zero due to our initial balance of payments equilibrium. In Chapters 5 and 6 we utilize the foregoing approach to measure the extent to which Canadian fiscal changes impose a real income burden on foreign incomes.

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[26] Note that if Canadian corporate taxes depress the net return to foreign capital, the loss in corporate income is replenished by a transfer from the foreign treasury, as long as the Canadian tax rate remains below the foreign rate. This is the treasury transfer effect alluded to earlier.

Part IV: The Interregional Model

We have so far described the structure of our federal revenue-sharing model. A variant of this model can be used to describe the distributive implications of a variety of provincial, tax-sharing experiments. This variant roughly doubles the dimensions of our previous model. In order to spare the reader some unnecessary eyestrain by presenting an even larger set of differential equations, we will merely indicate the nature of the additional equations needed for these experiments and not write them out in their full detail. A complete specification of these equations is to be found in Appendix A.

The main feature of this model is that we consider a small, open economy -- basically the provincial economy -- operating within the context of a much larger open economy, Canada. We are, thus, concerned with the pattern of interregional as well as international trade. Moreover, we restrict the ease of factor mobility and permit labor and capital to be less than perfectly mobile between the provincial jurisdiction and the rest of Canada. Let the previous set of equations (1)-(47) describe the operation of all the municipalities in a given province and denote all the provincially related variables with a "P" superscript. To this set of equations, we must add a similar set describing the functioning of the economy in the rest of Canada. Economic variables relevant for the rest of Canada are distinguished by an "r" superscript, enabling us to specify the following relationships in implicit, functional form:

(48) $H^r = H^r (K_H^r, N_H^r, L_H^r)$

(49) $P_K^r (1 + t_c) (1 + t_K) = H_K^r P_H^r$

(50) $P_N^r = H_N^r P_H^r$

(51) $P_{LH}^r (1 + t_L) = H_L^r P_H^r$

(52) $C^r = C^r (K_H^r, N_H^r)$

(53) $P_K^r (1 + t_c) (1 + t_K) = C_K^r P_c$

(54) $P_N^r = C_N^r P_c$

(55) $Z^r = Z^r (K_Z^r, N_Z^r)$

(56) $P_K^r (1 + t_c) (1 + t_K) = Z_K^r P_Z^r$

(57) $P_N^r = Z_N^r P_Z^r$

(58) $A^r = A^r (K_A^r, N_A^r, L_A^r)$

(59) $P_K^r (1 + t_c) (1 + t_K) = A_K^r P_A^r$

(60) $P_N^r = A_N^r P_A{}^r$

(61) $P_{LA}^r (1 + t_L) = A_L^r P \; {}^r A$

(62) $E^r = E^r (K_E^r, N_E^r)$

(63) $P_K^r (1 + t_c) (1 + t_K) = E_K P_E^r$

(64) $P_N^r = E_N P_E^r$

(65) $F^r = F^r (K_F^r, N_F^r, L_F^r)$

(66) $P_K^r (1 + t_K) (1 + t_c) = F_K P_F^r$

(67) $P_N^r = F_N P_F^r$

(68) $P_{LA}^r (1 + t_L) = F_L P_F^r$

(69) $H_d^r = H_d^r (P_c^*, P_M^*, P_H^{r*}, P_Z^{r*}, P_A^{r*}, I^r)$

(70) $M_d^r = M_d^r \, (P_c^*, P_M^*, P_H^{r*}, P_Z^{r*}, P_A^{r*}, I^r)$

(71) $C_d^r = C_d^r \, (P_c^*, P_M^*, P_H^{r*}, P_Z^{r*}, P_A^{r*}, I^r)$

(72) $A_d^r = A_d^r \, (P_c^*, P_M^*, P_H^{r*}, P_Z^{r*}, P_A^{r*}, I^r)$

(73) $C = C^P + C^r$

(74) $C = C_d^P + C_d^r$

(75) $M = M_d^P + M_d^r$

(76) $F = F^P + F^r$

(77) $E = E^P + E^r$

(78) $K = K^P + K^r$

(79) $K^P / K^r = f \, (P_K^P \, / \, P_K^r)$

(80) $\bar{N} = N^P + N^r$

(81) $N^P \, / \, N^r = g \, (P_N^P \, / \, P_N^r)$

(82) $L_H^r \, / \, (L_A^r + L_F^r) = h \, (P_{LH}^r \, / \, P_{LA}^r)$

(83) $K^P = \overset{8}{\Sigma} \, K_i^P$

(84) $K^r = \overset{6}{\Sigma} \, K_i^r$

(85) $N^P = \overset{8}{\Sigma} \, N_i^P$

(86) $N^r = \overset{6}{\Sigma} \, N_i^r$

(87) $\bar{L}^P = L_A^P + L_F^P + L_H^P$

(88) $\bar{L}^r = L_A^r + L_F^r + L_H^r$

(89) $$1^r = \sum_{i=1}^{6} K_i P_K^r \, (1 + t_c) \, (1 + t_K) + \sum_{i=1}^{6} N_i P_N^r + L_H^r \; P_{HL}^r$$
$$+ \, (L_A^r + L_F^r) \, P_{LA}^r + B_s - K_f P_K$$

(90) $1^r = P_M^* M_d^r + P_A^* A_d^r + P_Z^* Z_d^r + P_c^* C_d^r + P_H^* H_d^r$

Not all of these equations are new, in that some of them merely replace earlier ones specified in (1)-(47). Thus, equations (78) and (80) above are simply substitutes for the earlier equations (44) and (42). Similarly, equation (41) is now replaced by equation (87). In all, then, we have added forty new equations to help us determine the following list of new variables: H^r, Z^r, C^r, A^r, E^r, F^r, K^r_H, K^r_Z, K^r_c, K^r_A, K^r_E, K^r_F, N^r_H, N^r_Z, N^r_c, N^r_A, N^r_E, N^r_F, L^r_H, L^r_A, L^r_F, C, C^r_d, M^r_d, E, F, K^P, K^r, N^P, N^r, 1^r and the prices P^r_K, P^r_N, P^r_{LH}, P^r_{AL}, P^r_Z, P^r_A and P^r_H. There are thirty-eight variables in this list which, with the exception of C, E and F, refer to prices, income and resource employments in the rest of Canada. The presence of three dependent equations implies that there are an equal number of endogenous variables (82 in total) and independent equations. If both the provincial municipalities and the rest of Canada are operating on their budget constraints, gross-domestic, factor income equals total consumption by Canadians and the balance-of-payments equilibrium is automatically met. In addition, the fact that total income is exhausted by expenditures in both regions implies that one of the demand equations in each of these areas can be determined residually.

A useful way of focusing on this interdependence in demand is to examine the range of interregional trading patterns that are permissible. As we have specified the model, the prices of corporate output, both export types and imports, are common to both regions of Canada.[27] All other outputs, H, T, Z, G and A, are assumed to be locally produced and locally consumed since, excluding A, they are, by and large, of a service nature.[28] If the provincial municipalities are satisfying their budget constraint, their exports to the rest of the world must balance their imports from outside the region. In terms of our notation, this means $P_cE^P + P_FF^P + P_c\ (C^P - D^P_d) = P_MM^P_d$. Similarly, the applicable budget constraint in the rest of Canada gives rise to the corresponding balance equation, $P_EE^r + P_FF^r + P_c\ (C^r - C^r_d) = P_MM^r_d$. Since $E = E^r + E^P$, $F = F^r + F^P$, $M = M^r_d + M^P_d$ and total interregional sales of corporate output must equal total production, the sum of the balance of payments conditions for each region must add up to the balance of payments for the whole country, $P_EE + P_FF = P_MM$, ignoring, for the moment, foreign capital income claims. Thus, if a region is a net exporter to the rest of the world, it is a net importer from the rest of Canada, and the other region must then be a net importer from the rest of the world and a net exporter to the rest of Canada.[29] Seen from yet another angle, if we were to employ both regional budget constraints and the national balance of payments condition, equations (33), (70), and (75) would become dependent relationships in the model.

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[27] There is some minor sleight of hand here. Prices should properly be written net of transport and distribution costs and would, thus, vary interregionally. To avoid notational confusion, we ignore this fact since, if these margins are fixed, price changes will be the same across regions and it is this feature which we want to emphasize in our model.

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[28] Note that the rest of Canada does not produce T in our model since we want to vary its production in only one region. Also, there is, no doubt, some interregional trade in A goods, but forcing the price of A to be equal across regions severely limits the range of permissible factor price changes and is for this reason ignored. See Chapter 6 for further discussion of this important point.

[29] An alternative way of stating the matter is to note that the pattern of interregional trade satisfies Walras's law, that the sum of the excess demands in the economy add up to zero.

With the admission of interregional trade in our provincial revenue-sharing model, we have opened up a further avenue for tax exporting. The regional trade linkage in corporate goods, C, makes it possible for the burden of fiscal changes occurring in a single province to be shared with the rest of Canada. By analogy with our earlier formulation of tax exporting, we have added an additional tradeable good so that for the i'th domestic region the measure of tax exporting becomes: $dR = V_E^i \hat{P}_E + V_F^i \hat{P}_F - V_M^i \hat{P}_M \pm V_c^i \hat{P}_c - V_{KF}^i \hat{P}_K$, where V_c^i is here the value of C goods either exported from, or imported into, the region, and the positive (negative) sign applies in the case of exports (imports). A region may lose or gain real income in response to its fiscal changes depending on the movement in its terms of trade with the rest of the world and the rest of Canada and on the fraction of externally-owned capital which it employs. Of course, the region may also experience real income changes arising from any excess burden of its fiscal changes.

We conclude this chapter with a few observations on some features of the provincial revenue-sharing model that may not be apparent. The regional economy in the rest of Canada produces and consumes every output found in the other region except urban transit services, T, as can be seen from equations (48)-(72) (note also that all prices appearing in the demand functions are intended to be gross of any sales tax or subsidy). Equations (79) and (81) make the interregional mobility of capital and labor a function of their respective net-of-tax prices and, in the case of labor, real, net-of-tax prices. That is, unlike the services of capital and land, the services of labor cannot normally be employed in an area unless the owner of these services also resides there. For this reason it is the real, after-tax wage, net money wages deflated by a regional cost of living index, that determines the attractiveness of a region for workers. For the sake of notational economy, we have not explicitly shown this deflation of regional money wages in writing equation (81). Discussion of the precise method used to measure labor's real wage is deferred until Chapter 6. A similar mobility relationship is designated in equation (82) for land, except that it refers to intra-regional mobility between housing and agriculture. Land, of course, cannot be inter-regionally mobile. Finally, it is assumed in equation (82) that land is perfectly mobile within the region between the predominantly agricultural activities A and F.

In the next chapter, we explain our attempts to attach some numerical meat to this theoretical skeleton and some of the compromises that we have reached with the available data. This chapter has been an essential prelude to that exercise.

Chapter 3

Data Requirements, the Initial Equilibrium and the Choice of Parameter Values

In order to make the incidence models of the preceding chapter operational, we need data which characterize the relevant dimensions of the Canadian economy and which conform to the concepts we have constructed. The purpose of this chapter is to describe our attempts to meet this need. With at least partial success, we have sought to reconcile and integrate three disparate sets of information in our attempt to achieve a consistent and, for our model, appropriate, picture of the Canadian economy. Our basic data are derived from the Canadian input-output table, the recent surveys of family expenditure and income distribution, and the national accounts. Our estimates and calculations are centered on the year 1969, since that is the period in which the surveys were conducted and the year for which we have the most reliable tax data. Since 1969 was a year in which the national unemployment rate of 4.7 per cent was close to the historical post-war average rate, we do not believe our estimates are disturbed by cyclical considerations. Often the results of estimates obtained for a particular year will be marred by macroeconomic fluctuations but, in this case, 1969 appears to be as typical or average a year as one is likely to find. While we feel our estimates for 1969 are quite good, we should point out that in some cases the available data provide only a rough approximation to what we would ideally like to have had. In the first part of this chapter we discuss our measurement of the size of various sectors and incomes and, in the second part, we describe our estimates of assorted parameter values.

Part I: Numerical Dimensions of Canada's Economy

Most of the information on production and factor shares, and much of the tax data, are collected and published on the basis of industry divisions. On the other hand, virtually all of the information available on consumer demand refers to some type of final commodity aggregation. The input-output model of the Canadian economy offers the only vehicle known to us which can consistently link up these two strands of information. With the aid of Statistics Canada, we used the most current version of the input-output model, 1966, to obtain some special tables showing how various categories of final demand translate into the values-added of the different one-digit industries that furnish the factor services needed to produce the final commodities.[1] That is, each dollar of final demand calls forth a dollar's worth of imports, indirect taxes and value-added of domestic supplying industries, both directly and indirectly, through the many different intermediate stages of production.[2]

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[1] We would like to express our appreciation to the input-output division of Statistics Canada for their cooperation and prompt, reasonably priced services. A description of the data is available in The Input-Output Structure of the Canadian Economy, 1961-66, Statistics Canada, Input-Output Division, January 1976, No. 15-505E.

[2] In matrix notation, our tables can be represented by the equation $VA = \lambda\ (I - DB)^{-1}De'$, where VA is a value-added matrix, λ is a diagonal matrix of ratios of value added to gross output, I is the identity matrix, D is a matrix of market shares by industry, B is a matrix of industry inputs and e is a vector of final demands. If a_{ij} represents a typical input-output coefficient and there are n different industries, the matrix λ consists of the diagonal elements $(1 - \sum_{i=1}^{n} a_{i1}) \ldots (1 - \sum_{i=1}^{n} a_{in})$ and zeros for all of the off-diagonal elements.

Taking interindustry relationships into account, consumers may be viewed as demanding, for each category of final demand, a certain amount of value-added from every one-digit industry. After working through the input-output model in this fashion and after some experimentation, we settled on the following aggregation of demand categories to form our precise definitions of final commodities:

A = expenditures on food products and non-alcoholic beverages
H = expenditures on gross paid and imputed rent and lodging
E + F = foreign expenditures on exports
W = investment expenditures on construction, machinery and equipment
Z = educational and cultural services, medical and hospital care services, expenditures on restaurants and hotels, and household and personal care services
C = expenditures on alcohol and tobacco, clothing and footwear, household furnishings and supplies, reading and recreation, travel and transportation.

We initially disaggregated C and Z into their major constituent groups to see if there was any significant variation in production structure or tax treatment. While the structure of value-added did vary noticeably within the C aggregate, the relevant tax rates did not. We formed the commodity combinations indicated by using a weighted average of final expenditures within each category to obtain each aggregate consumer good and its pattern of value-added coefficients associated with a dollar's worth of final demand.[3] Using the input-output value coefficients for imports and indirect taxes, we next adjusted the coefficients for the industry value-added of each final demand aggregate so that they represented the fractions of industry value-added needed to satisfy a net-of-tax, dollar's worth of final expenditure on domestically supplied output.[4]

Since our model only describes the behavior of firms in private sectors of the economy, we were faced with the problem of how to treat public enterprises whose pricing and factor employment decisions would be inadequately described by our competitively based equations. We decided to exclude them from consideration in the same way as we made the preceding exclusions for imports and indirect taxes. For each final demand aggregate, we netted out all the value-added furnished by public utilities and relevant portions of the value-added for transport and communication.[5] All the remaining value-added coefficients were then augmented through their division by one minus the fraction of value-added subtracted for public enterprise. The results of these manipulations are presented in Table 3-1 which shows the amounts of value-added needed in each industry to produce a dollar of final expenditure on commodities net of the value-added purchased from public enterprises.

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[3] In terms of the typical broad commodity classification, C is comprised of 7 durables, 5 semi-durables, 5 non-durables and 3 services (automobile-related and recreational). Z and H are composed of 8 and 3 services, respectively, while A is made up of one non-durable.

[4] That is, for each final commodity we divided the raw input-output coefficients by one minus the sum of the value coefficients for imports and indirect taxes.

[5] From the annual Corporations and Labor Unions Returns Act, Part I, Corporations. No. 61-210, Statistics Canada, 1970, it appears that 84, 50 and 21 per cent of the assets employed in utilities, transport and communications respectively, are owned and operated by public enterprises. We used these percentages to make adjustments to the value-added coefficients for each industry.

Some further clarification of the elements in Table 3-1 is warranted. The investment expenditure category W obviously does not correspond to the commodity concepts in our model. It is included here to enable us more easily to work with other sets of data which draw a clear distinction between total consumption and saving. Ultimately, we will treat saving as the purchase of capital goods, and amalgamate W into the corporate good category C, since its tax treatment clearly dictates that it belongs there. Also, final expenditures on exports are obviously not conveniently broken down into expenditures on E- and F-type exports in the input-output table. Rather, we have divided the total export expenditure vector into the two kinds of export activity according to the following observations. First, there is not much empirical evidence to support the notion of a relatively large F-type export sector. Only homogeneous products for which Canada is a small supplier to the world seem to qualify for inclusion in this category. Only agricultural products and perhaps a small portion of manufactured exports seem to fit this description.[6] For other exports there is sufficient quality or brand differentiation, or the existence of a dominant market position, to merit the view that they belong in our flexibly priced export activity. Accordingly, we designated F to consist of all

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[6] Even in the case of agriculture, we cannot be entirely certain that this assumption is appropriate since Canada is not a marginal supplier in world markets for most products, and agricultural supplies in competing countries do not adjust quickly to price changes. A recent study, for example, estimates the price elasticity of the excess demand function for Canadian wheat to be about -9. See D. McLaren, "The Canadian Wheat Economy in the World Setting", Working Paper No. 2, Agriculture Canada, August 1975.

Table 3-1

Value-Added Coefficients Per Dollar of Expenditure on Final Output

Sector \ Final Demand	A	C	H	Z	W	E	F
Agriculture	.36	.026	-	.035	.004	-	.70
Forestry	.004	.005	.001	.004	.009	.051	-
Mining	.012	.015	.002	.005	.03	.20	-
Construction	.015	.01	.074	.01	.3	.016	.016
Manufacturing	.25	.39	.025	.09	.4	.503	.055
Transport, Communications and Utilities	.054	.09	.009	.03	.05	.094	.094
Wholesale Trade	.075	.08	.006	.022	.10	.056	.056
Retail Trade	.16	.263	.003	.033	.01	.013	.013
Finance and Insurance	.04	.064	.03	.055	.058	.033	.033
Real Estate	-	-	.23	-	-	-	-
Owner-Occupied Dwellings	-	-	.60	-	-	-	-
Commercial Services	.03	.055	.02	.716	.039	.033	.033

NOTE: The coefficients in each column sum to unity.

agricultural exports plus 10 per cent of manufactured exports, a grouping which in size amounts to 16.5 per cent of total exports.[7] We also assumed that the coefficients of the supporting trade and service sectors were the same for both export types. Finally, note that the predominantly corporate activities, C and E, together comprise about 60 per cent of total, private, economic activity in the model.

Armed with the information in Table 3-1, we proceed to disaggregate the value-added of each one-digit industry into value shares for labor and capital, and the latter into corporate plus property tax payments and the net, or after-tax, income received by owners of capital. In making this separation, we rely on revised national accounts data for the year 1969 and an unpublished study by Glenn P. Jenkins containing estimates of capital taxes paid by each industry for various years, including 1969.[8] The most difficult problem faced in obtaining satisfactory estimates of factor shares is the method used to partition into capital and labor payments, the noncorporate income in each sector.

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[7] In the input-output export vector, about \$.116 of every dollar of net exports represented agricultural exports. If every dollar of F-type exports results in \$.055 of manufacturing value-added, about \$.70 is then attributable in agricultural exports and the balance to the distributive-financial sectors. Forming the appropriate weighted average for agricultural exports, we have $\$.116 = (F/F+E)\ \$.7$ or $F/(E + F) = .165$

[8] System of National Accounts. National Income and Expenditure Accounts. Vol. 1, The Annual Estimates, 1926-1974, No. 13-531, Statistics Canada; Glenn P. Jenkins, "Analysis of Rates of Return from Capital in Canada". Unpublished Ph.D. dissertation, University of Chicago, 1972.

In using Jenkins's data, we adopt his assumption that net-of-tax returns to capital are equalized between the corporate and noncorporate parts of each industry. In Appendix B the interested reader will find a detailed discussion of our measurement of industry factor shares, and effective industry tax rates imposed on capital income by the corporate income and property taxes.

Applying the factor share and tax rate data found in Appendix B to the figures contained in Table 3-1 results in Table 3-2, which displays estimates of the functional income shares for each of the final demand commodities in our model. This table gives the direct and indirect factor content of each consumption aggregate -- it translates final demand expenditures into factor incomes. Several features of these estimates merit further comment. As a group, the commodities with a heavy concentration of noncorporate output, A, H, Z and F, are somewhat less labor intensive, i.e., have a lower labor share, than the other, more corporate-based, commodities, C, W and E. The difference, however, is not strikingly large and in the case of commercial services, Z, it goes slightly in the other direction. Also, when the share of capital is split into its land and reproducible capital components, the difference in reproducible capital share is barely discernible except in the case of housing services, or expenditures on gross rents. Within the group of corporate-dominated final commodities, the flexibly priced export sector is noticeably more capital intensive than the other two. This tendency mirrors the importance of the mining sector in this activity and the fact that manufactured exports seem to be more capital intensive than manufactured goods sold domestically.[9]

Another interesting feature of Table 3-2 is that the commodities with relatively low effective corporate income tax rates tend to have relatively high effective property tax rates, largely due to the use of taxed land as in the case of A and H. As a result, the inter-industry variance in the sum of the tax rates on capital income is much less than the variance in either of the individual rates. Also, because of their similar tax treatment, no distortion is created if C and W are combined to form a single aggregate. Finally, while both C and Z have some land income, it is such a small income share (less than one per cent) that it can be safely ignored and included in the share of income attributable to reproducible capital.

This is a convenient point at which to pause and attempt partially to assess the accuracy or validity of our approach as we have so far developed it. We first of all check our results for consistency with production data from the national accounts. In 1969, national expenditures on C, A, Z, H and W were (in millions) \$22,272, \$7,445, \$8,486, \$7,102 and \$15,240, respectively, while foreign expenditures on merchandise exports were about \$14,083.[10] Net of imports and indirect taxes,

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[9] This property of the manufacturing sector is also noted in a study by B. W. Wilkinson, Canada's International Trade: An Analysis of Recent Trends and Patterns, Montreal: The Private Planning Association of Canada, 1968.

[10] National Income and Expenditure Accounts, Vol. 1, Statistics Canada, No. 13-531, and Summary of Exports, Statistics Canada, No. 65-002. We have excluded inventory investment since it has no place in our model, and we have ignored about \$400,000 worth of exports, mainly fish and fur products, for the same reason.

Table 3-2

Income Shares and Effective Tax Rates for Final Commodities

Income Share of: \ Commodity	A	C	H	Z	W	E	F
Labor	.58	.68	.12	.72	.71	.625	.486
Gross Capital	.42	.32	.88	.28	.29	.375	.514
Depreciation	.13	.10	.03	.08	.07	.105	.194
Net Capital	.29	.22	.85	.20	.22	.27	.32
Land	.06	.005	.25	.007	-	-	.12
Reproducible Capital	.23	.215	.60	.193	.22	.27	.20
Effective Tax Rate for:							
Corporate Income Tax	.145	.263	.009	.184	.284	.276	.053
Property Tax	.166	.103	.304	.106	.074	.073	.215
Total Capital Taxes	.311	.366	.313	.29	.358	.349	.268
Effective Subsidy							
To Capital Income	.103	-	-	-	-	-	.179

Notes: [1] Effective tax rates are the ratio of taxes paid to net-of-depreciation capital income.

[2] Jenkins observes that a plethora of agricultural support programs effectively reduces the cost of capital to this sector, so we have used his estimates of these subsidies to calculate an effective subsidy rate for A and F. See Jenkins, op. cit.

Source

Appendix B of this study.

these expenditures (in millions) amounted to $12,806 for C, $5,666 for A, $6,958 for Z, $6,442 for H, $11,511 for W and $9,745 for E and F. As percentages of total, net expenditure on domestic output, they amount to 24.2, 10.7, 13.1, 12, 21.7, and 18.3 per cent, respectively. If these expenditure weights are applied to the value-added coefficients in Table 3-1, the percentage contributions of each industry in meeting final demands should reasonably approximate the relative size of each industry in GDP at factor cost. However, to make a proper comparison with published GDP figures requires an adjustment for our exclusion of some components of GDP. These exclusions consist of public administration, non-commercial services and the public enterprises in utilities, communications and transport. In total, these exclusions amount to about 25.4 per cent of recorded GDP in 1969.

After adjusting for these exclusions, we arrive at the comparisons shown in Table 3-3. As can be seen from this table, the differences between our estimated contributions to GDP and those recorded in the national accounts are quite small, the largest discrepancy being about two percentage points in the case of commercial services. An exact correspondence would not be expected in any event, after all, since we are applying 1969 expenditure patterns to the 1966 input-output structure. Since the agricultural share of GDP declined over this interval, it is not surprising, for example, that we overestimate its contribution by about 1.3 percentage points.

While this last exercise bolsters our confidence in the accuracy of our approach, a further check can be made by comparing the total

Table 3-3

A Comparison of Percentage Contributions to GDP

1) Estimated Contribution from the Input-Output Table

2) Recorded Contribution from National Accounts Data

Industry

	Agri-culture	Forestry	Mining	Con-struction	Manu facturing	Transport et. al	Whole-sale Trade	Retail Trade	Finance and Real Estate	Commercial Services
1)	6.3	1.35	4.9	8.2	32.4	6.07	6.29	9.00	13.9	11.7
2)	4.96	1.2	5.01	8.57	32.7	6.78	6.7	9.5	15.2	8.9

Source

Table 3-2 and National Income and Expenditure Accounts, Vol. 1, Statistics Canada, No. 13-531.

factor payments and taxes implicit in Table 3-2 with published data. Multiplying the factor shares and tax rates of Table 3-2 by the net-of-import-and-indirect-tax expenditures for each commodity gives us the results shown in Table 3-4. All of the figures for total income and taxes in this table compare favorably with those found in the national accounts for 1969 and with those used in other incidence studies. In the accounts, wages paid by business (both private and public) are listed as $32,506 mn. compared to our figure of $31,810 mn. which excludes public enterprises. For depreciation charges, the accounts give $5,112 mn. for the whole economy as against our figure of $4,743 mn.[11] After an allowance for our excluded activities, corporate income taxes contained in the accounts amount to $2,962 mn. However, Maslove, in his study of tax incidence, uses a total figure of $2,627.7 mn. which is very close to our value of $2,637 mn.[12] Property taxes are not separated from other indirect taxes in the accounts but we note here that Gillespie's recent study of fiscal incidence uses a total for property taxes of $2,824.8 mn. and that the publication Local Government Finance (Statistics Canada, No. 68-204) lists real property taxes collected by municipalities, but not provinces, as $2,783.6 mn.[13] All of these

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[11] Another publication, Fixed Capital Flows and Stocks, Statistics Canada, No. 13-211, gives total depreciation, excluding utilities, of $4,710 mn. in 1969.

[12] Allan M. Maslove, op. cit. Some portion of the national accounts figure may reflect accruals rather than amounts actually paid.

[13] W. I. Gillespie, op. cit. Although we express property tax rates on the basis of capital income, there is no difficulty in measuring the same taxes on the basis of capital value. For example, if the interest rate is 10 per cent, our property tax rate on housing services of .304 is equivalent to a rate of about 3 per cent on housing values.

New Brunswick, for example, levies a province-wide, property tax to finance its municipalities and is unique in that respect.

Table 3-4

Sources of Factor Income and Tax Payments for Final Commodities

(millions)

Commodity:	A	C	H	Z	W	E	F	Total
Net Spending (millions)	$5,666	$12,806	$6,412	$6,958	$11,511	$8,088	$1,657	$53,128
Labor Income	3,286	8,708	733	5,010	8,173	5,055	805	31,810
Gross Capital Income	2,380	4,098	5,669	1,948	3,338	3,033	852	21,318
Depreciation	736	1,281	193	556	806	849	322	4,743
Net Capital Income	1,644	2,817	5,476	1,392	2,532	2,184	530	16,575
Land Income	340	64	1,610	49	-	-	199	2,262
Reproducible Capital Income	1,304	2,753	3,866	1,343	2,532	2,184	331	14,313
Corporate Taxes	238	740	52	256	719	603	28	2,636
Property Taxes	273	290	1,664	148	187	159	114	2,835
Total Capital Taxes	511	1,030	1,716	404	906	762	142	5,471
After-tax Capital Income	1,133	1,786	3,760	988	1,726	1,422	388	11,204

Source: Table 3-2.

comparisons indicate that no serious distortions have arisen from the attempt to link up final demands with the structure of the economy's production relationships.

We proceed from here to use the data in Table 3-4 to help construct some basic macroeconomic linkages for 1969 that are indispensable in establishing a wholly consistent profile of the size distribution of income. Our first need is to construct a consolidated government sector account and a plausible current account for the balance of payments. Since the capital account is not incorporated into our model, we ignore it in designing a suitable initial equilibrium. Total exports of goods on the merchandise account are taken to be $14,083 mn., as before, while export expenditures, net of imports used in export production, are $10,872 mn., and net of indirect taxes are $9,745. Merchandise imports we take to be worth $13,000 mn., leaving a margin of $1,083 mn. for foreign capital payments.[14] Thus, imports purchased, net of those used in exports, amount to $9,789 mn.

A precise determination of the budgets for the public and private sectors can now be made. As in our earlier GDP calculations, total national expenditures on A, C, Z, H and W were, respectively, $7,445 mn., $22,272 mn., $8,486 mn., $7,102 mn. and $15,240 mn. for a sum of $60,545 mn. worth of national expenditure. In the national accounts, governments' exhaustive expenditure was about $14,136 mn., of which about $9,800 was allocated to direct labor purchases, $3,186 mn. was saved via a surplus and the residual amount, $1,150 mn. we assume was spent on non-imports of C, A, H and Z. The budgets for the two sectors then appear as below:

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[14] Actual payments to foreign capitalists were somewhat larger than this amount, of the order of $2,099 mn. for the year. A large but unknown amount of this sum represents payments to foreign holders of government debt that was incurred only in part to augment the capital stock in Canada. Our figure for repatriated earnings is close to the national accounts estimate of paid, non-resident dividends of $837 mn. and to the estimated difference between merchandise exports and imports of $817 mn. Note that we adhere to the accounting convention of including in GNP the retained earnings and depreciation allowances of foreign-owned companies.

Table 3-5

Budgets for the Private and Public Sectors

(millions)

	Expenditures on:					Income (GNP)
			Domestic Goods			
Sector	Imports	Labor	CAHZ	W		
Governments	-	$9,800	$ 1,150	$ 3,186	=	$14,136
Private Sector	$9,789	-	$34,366	$12,054	=	$56,209
	$9,789	$9,800	$35,516	$15,240		$70,345

With this data we can quickly ascertain the dimensions of the total government budget. From Table 3-4 we see that, as a result of domestic and foreign spending, the private sector received $47,657 mn. after payment of corporate income and property taxes. Yet, it required $56,209 mn. to make the expenditures (including saving which, to repeat, we view as an expenditure) shown in Table 3-5. Transfer payments of $8,552 mn. must have been made by governments in order to fill this gap. We include subsidies of all forms here as another method of making transfer payments rather than substracting these from indirect taxes as practiced in the national accounts. Therefore, total government expenses are $22,688 mn., an amount which is financed by $5,471 mn. in property and corporate income taxes, $8,500 mn. in indirect (commodity or sales) taxes, and a residual of $8,717 mn. in personal income taxes, a figure that is not too far removed from the national accounts value of $7,464 mn. Our larger number, of course, subsumes social security, estate and other minor taxes which we ignore in the subsequent analysis.

The consistency of these figures can be verified in any number of ways. Three examples follow:

(1) Alternative Calculation of Disposable Private Income

$47,657 mn.	- private sector income from total expenditure net of corporate income and property taxes
+$ 9,800 mn.	- government purchase of labor services
$57,457 mn.	- personal income
-$ 8,717 mn.	- personal income taxes
+$ 8,452 mn.	- transfer payments to individuals, direct and indirect
$57,292 mn.	- disposable income (domestic and foreign)
-$ 1,083 mn.	- foreign factor payments
$56,209 mn.	- national disposable income

(2) Alternative Calculation of GNP

$50,756 mn.	- total domestic spending on domestic output plus indirect taxes on imports
-$ 7,373 mn.	- indirect taxes on domestically purchased goods
$43,383 mn.	- domestic spending on domestic goods net of imports and indirect taxes on all purchases (see Table 3-4)

+$ 9,789 mn. - purchase of imports (net of imports used in exports)

$53,172 mn. - domestic expenditure on goods net of indirect taxes

+$ 9,800 mn. - government purchase of labor

$62,972 mn. - gross national income at factor cost

+(8,500-1,127) mn. - indirect taxes on domestic purchases (net of those on exports)

$70,345 mn. - GNP

(3) Alternative Calculation of GNP and GDP

$60,545 mn. - sum of final expenditures on W, C, A, Z and H

+$ 9,800 mn. - government purchase of labor

$70,345 mn. - GNP

-$ 9,789 mn. - net imports purchased

$60,556 mn. - expenditure on domestic goods and labor

+$10,872 mn. - exports net of imports used

$71,428 mn. - GDP

As it should be, the gap between GDP and GNP is equal to the difference between exports and imports. Actual GNP recorded in 1969 was $79,815 mn., leaving a discrepancy of $9,470 mn. to be explained by our exclusion of utilities, operating expenses of non-profit organizations, expenditures abroad, inventory and other investment, exports of services (non-merchandise exports) plus the residual error. The sum of these items in 1969 was $9,450 mn.

We turn next to our calculations of indirect taxes and rates shown in part I of Table 3-6. With some minor adjustments to make the total of indirect taxes amount to $8,500, the ad valorem rates are those given in the input-output table.[15] As before, the difference between final expenditure and expenditure net of imports ($60,545 - $50,756 mn.) is equal to net purchases of imports ($9,789 mn.). Moreover, the sum of imports purchased plus indirect taxes ($9,789 mn. plus $7,373 mn.) is the difference between domestic purchases and domestic expenditure net of these items. There are few ways of confirming the accuracy of our indirect tax rates since published data on rates refer to quite different bases than the ones shown in Table 3-6. However, an indirect check is possible. Weighting the individual rates by expenditure shares results in a weighted-average, indirect tax rate of .143. Using an approach similar to our own, Campbell has recently estimated an average, indirect tax rate of .138 for Canada.[16] His finding corroborates ours, unless it could be shown that there was a significant change in the level of the rates between 1961 and 1966, since his estimate relies on the 1961 version of the input-output table.

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[15] Note here that some of our tax rates have been expressed so far in terms of rates on gross-of-tax factor incomes and gross-of-tax product prices, whereas in our model we use rates applied to net-of-tax prices and incomes. In applying the model, we make the appropriate rate conversion.

[16] Harry F. Campbell, "An Input-Output Analysis of the Commodity Structure of Indirect Taxes in Canada", The Canadian Journal of Economics, August 1975. Corporate output, C, bears the heaviest indirect tax burden because, to a much larger degree than other outputs, it is exposed to the federal manufacturers sales tax, the eleven per cent tax on building materials and the high excises levied on gasoline, automobiles, and liquor and tobacco products. Although more lightly taxed, the services contained in Z are liable, for example, to the levies imposed on restaurant meals, motels, hotels and theaters.

Table 3-6

I. Indirect Taxes and Rates for Final Commodities

(millions)

Commodity	A	C	H	W	Z	(E+F)	Total
Final Expenditure	$7,445	22,272	7,102	15,240	8,486	14,083	$60,545 net of exports
Indirect Tax Rate	.07	.21	.07	.128	.122	.08	
Indirect Taxes	$ 521	3,381	483	1,951	1,036	1,127	8,500
Domestic Expenditures net of Imports and Indirect Taxes	$5,666	12,806	6,442	11,511	6,958	-	43,383
Domestic Expenditure Net of Imports	$6,188	16,187	6,925	13,462	7,994	-	50,756

II. Private and Public Spending Patterns for Commodities

(millions)

Expenditure by \ on	A	C	H	Z	Sum	Imports of A,C,H,Z	Domestic output of W	Imports of W	
Governments	$ 100	650	200	200	1,150	-	3,186	-	3,186
Private Sector	$6,088	15,537	6,725	7,794	36,144	8,011	10,276	1,778	12,054
	$6,188	16,187	6,925	7,994	37,294	8,011	13,462	1,778	15,240

Source

(1) The Input-Output Table for 1966, Structure of the Canadian Economy 1961-66, Statistics Canada, No. 15-505E.
(2) National Income and Expenditure Accounts, Vol. 1, Statistics Canada, No. 13-531.
(3) Table 3-5 of this study.

We return now to the private and public budgets exhibited in Table 3-5, and disaggregate according to commodities. This is done in Part II of Table 3-6 where we make a guess about the government division of expenditures of A, C, H, and Z. This guess gives the pattern of private expenditures on these items as a residual. Since total expenditures on these items are \$45,305 mn. (see line (1) Table 3-6, part I), we know from part I of the table that imports of these goods, net of indirect taxes, amount to \$8,011 mn. Also, from Table 3-5 we can infer that \$35,516 mn. is spent on domestic production of these goods, inclusive of indirect taxes, while, from part I of Table 3-6, it is seen that \$37,294 mn. is the total amount, inclusive of indirect taxes on imports of these goods. The difference represents the amount of indirect tax paid on these imports, \$1,778 mn., and is already implicitly included in the last row of Table 3-6, part I, since indirect taxes apply to both imports and domestic versions of these goods.[17] We treat expenditures (saving) on W in the same manner in part II of this table. It may also be noted that the sum of private sector expenditures (on domestic output, plus imports and indirect taxes on both) add up to private disposable income of \$56,209 mn.

We are finally in a position to distribute the components of private, "disposable" income and private expenditures according to income class. Because it includes imputed income, this concept of disposable income differs from the usual "cash-in-hand" measurement of this variable. Total labor income is $41,610 mn., the sum of wages paid by government ($9,800 mn.) and business ($31,810 mn.) Total capital income is that earned by business after taxes ($15,847 mn.) less earnings paid to foreigners ($1,083 mn.) or $14,764 mn. Capital income, including depreciation, is attributed to different income groups whether or not it is actually received, an implicit acceptance of the conduit view of business organization. To make these attributions, we rely mainly on a set of distributive series used in earlier incidence studies and which are ultimately derived from the Income Distribution Survey conducted by Statistics Canada in 1969. These are shown in Table 3-7. There is some question concerning the most appropriate series to use in distributing capital income. We believe the information on net worth is most suitable since other series, such as dividends or interest income received, fail to recognize that debt may be used to earn capital income and suggest an improbable degree of concentration for capital ownership. Net worth is the best proxy for capital ownership since it considers liabilities on a par with asset holdings. It also embraces a more comprehensive concept of capital than alternative series which do not include home ownership as a capital asset. Ownership of homes figures prominantly in the assets of most families, especially those in the middle and lower income groups. Equity in pension funds and life insurance policies, however, was unfortunately excluded from the data.[18]

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[17] That is, expenditures on A, in Table 3-6, for example, include the taxes paid on the imports of A goods, since we treat imports as a separate, aggregate good in the model.

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[18] For a useful description and analysis of the net worth data, see J. R. Podoluk, "Measurement of the Distribution of Wealth in Canada",
(continued on p. 98)

Table 3-7

Distributive Series Used to Allocate Incomes and Personal Taxes

Income Class	Labor Income	Capital Income	Personal Income Taxes	Transfer Payments	Total Consumption	Number of Families
under $3,000	.017	.04	.008	.33	.079	.203
3,000- 3,999	.023	.051	.013	.125	.046	.078
4,000- 4,999	.037	.053	.023	.09	.056	.076
5,000- 5,999	.056	.054	.038	.07	.066	.08
6,000- 6,999	.069	.06	.051	.07	.074	.079
7,000- 7,999	.089	.06	.069	.06	.087	.084
8,000- 8,999	.091	.08	.075	.055	.086	.075
9,000- 9,999	.083	.085	.075	.035	.075	.061
10,000-10,999	.085	.065	.081	.03	.075	.056
11,000-11,999	.073	.07	.067	.025	.061	.043
12,000-14,999	.161	.13	.169	.05	.127	.083
over 15,000	.216	.26	.331	.06	.169	.083
all classes	1	1	1	1	1	1

Sources

(1) All of the series, except that for capital income, are taken from the study by Allan M. Maslove, The Pattern of Taxation in Canada, Ottawa: Economic Council of Canada, December 1972. For a smaller range of income classes, Gillespie has used the same allocative series as Maslove. See W. Irwin Gillespie, "The Redistribution of Income in Canada, 1969: An Analysis of the Incidence of Taxes and Public Expenditures in the Canadian Economy", mimeographed, 1975.

(2) For the allocation of capital income, we have used an interpolated net-worth series extracted from Incomes, Assets and Indebtedness of Families in Canada, 1969, Statistics Canada, No. 13-547. According to this bulletin, the asset and debt data are substantially underestimated. This bias is probably most important at the upper-income levels so we have smoothed the series according to the data on U.S. wealth holdings found in Musgrave, Case and Leonard, op. cit. As a result, we reduce the reported share of capital income of the bottom group by a factor of two.

Note

(1) The number of families in the last column refers to families and unattached individuals as defined in Income Distributions by Size in Canada, 1969, Statistics Canada, No. 13-544.

Our estimates of the size distribution of income are shown in the first part of Table 3-8. Saving (expenditure on W) attributed to each income class is estimated residually. On the expenditure side, we allocate expenditures on A, C, H, Z and M to income groups on the basis of the expenditure patterns revealed by the 1969 survey of family spending.[19] The results of this allocation are presented in the second part of Table 3-8. The main feature of the expenditure patterns is the sharp decline in the fraction of income devoted to food commodities (A) as average income rises and the strong increase in the fraction spent on corporate output (C) at higher income levels. Expenditures on H, Z and M vary more or less proportionately with average family income.[22] The expenditure coefficients used to derive these figures are gathered in Table 3-9.

The Review of Income and Wealth, June 1974. Her series corresponds closely to the one shown in Table 3-7. Due to the preponderance of the retired aged at the bottom of the income scale, most of whom own their home, the bottom income group receives more of its income from capital than from labor. Podoluk also notes that within any given income level there is enormous variation in the wealth holdings of different individuals. In fact, the lower the level of income, the larger is the inequality in asset holdings.

Inclusion of pension fund equity in the net worth series could significantly alter the shape of that distribution. In the U.S., for example, it has been found that workers' pension plans now own one-third of all corporate equity. See P. Drucker, The Unseen Revolution: How Pension Fund Socialism Came to America, Harper and Row, 1976.

[19] Family Expenditure in Canada, Vol. 1, 1969, Statistics Canada, No. 62-535.

[20] One problem with all of this data is that it probably masks considerable variation in factor ownership and expenditure patterns occurring within each income class. Part of the price we pay for focusing exclusively on vertical equity is that we have nothing to say about the horizontal equity of different fiscal changes. This neglect obscures some of the welfare implications of our results. A more refined analysis, the data allowing, might focus on factor ownership by age, sex, race, or other criteria that may be relevant to socio-economic policy.

Table 3-8

Size Distribution of Income and Expenditures

I. Disposable Income by Income Class
(millions)

Income Class	Labor Income	Capital Income	Transfer Payments	Personal Income Taxes	Disposable Income	Total Consumption	Saving
under $3,000	$ 498	$ 413	$ 2,822	$ 78	$ 3,655	$ 3,488	$ 167
3,000- 3,999	956	760	1,069	113	2,672	2,031	641
4,000- 4,999	1,539	793	770	201	2,901	2,428	473
5,000- 5,999	2,330	797	598	331	3,394	2,914	480
6,000- 6,999	2,872	880	598	445	3,911	3,268	643
7,000- 7,999	3,704	880	513	601	4,502	3,842	660
8,000- 8,999	3,828	1,183	471	654	4,828	3,797	1,031
9,000- 9,999	3,579	1,185	300	654	4,410	3,312	1,098
10,000-10,999	3,579	1,038	256	706	4,167	3,312	855
11,000-11,999	3,038	1,037	214	584	3,705	2,693	1,012
12,000-14,999	6,699	1,927	428	1,473	7,581	5,608	1,973
over $15,000	8,988	3,859	513	2,877	10,483	7,462	3,021
all classes	$41,610	$14,764	$ 8,552	$ 8,717	$56,209	$44,155	$12,054

II. Expenditures by Income Class
(millions)

	Commodity					
	A	C	H	Z	M	Total
under $3,000	682	856	712	607	631	3,488
3,000- 3,999	373	611	353	325	369	2,031
4,000- 4,999	413	796	372	386	461	2,428
5,000- 5,999	478	980	447	464	545	2,914
6,000- 6,999	515	1,123	501	521	608	3,268
7,000- 7,999	578	1,320	621	613	710	3,842
8,000- 8,999	546	1,341	580	645	685	3,797
9,000- 9,999	438	1,167	506	563	638	3,312
10,000-10,999	428	1,200	506	563	615	3,312
11,000-11,999	336	1,002	375	485	495	2,693
12,000-14,999	673	2,111	772	1,058	994	5,608
over $15,000	630	3,030	980	1,564	1,258	7,462
all classes	$6,088	$15,337	$6,725	$7,794	$8,011	$44,155

Table 3-9

Expenditure Coefficients by Income Class

	Commodity					
Income Class	A	C	H	Z	M	Sum
under $3,000	.249	.264	.189	.154	.144	1
3,000- 3,999	.234	.324	.161	.142	.143	1
4,000- 4,999	.216	.353	.142	.141	.145	1
5,000- 5,999	.208	.362	.142	.141	.147	1
6,000- 6,999	.199	.37	.142	.141	.15	1
7,000- 7,999	.191	.37	.15	.141	.148	1
8,000- 8,999	.185	.38	.142	.15	.144	1
9,000- 9,999	.17	.38	.142	.15	.158	1
10,000-10,999	.166	.39	.142	.15	.152	1
11,000-11,999	.16	.40	.129	.158	.153	1
12,000-14,999	.155	.405	.128	.166	.146	1
over $15,000	.11	.437	.122	.184	.147	1

Source: Family Expenditure in Canada, Vol. 1, All Canada: Urban and Rural, 1969. Statistics Canada, No. 62-535.

In making the division of expenditures between domestic output and imports, we have used the ratio of imports to total consumption given by the 1966 input-output table and have assumed that each income class allocates its expenditure between domestic output and imports in the same proportion. This procedure, of course, may be incorrect but we know of no method which would allow us to check the assumption. Application of these coefficients to the consumption totals for each income class gives us the amounts shown in Table 3-8, part II, after making a small proportional adjustment to ensure that the sum of each income class' consumption adds up to the aggregate consumption of each commodity.

The values of the various economic variables contained in Tables 3-1 to 3-8 provide us with a consistent description of our assumed initial equilibrium of the Canadian economy in 1969. It is this initial position which we disturb in each of our fiscal experiments and which we use to compare with the unobserved equilibria predicted by our fiscal incidence model. If income distribution changes, it is always with reference to the snapshot picture of the economy that we have just constructed.

Part II: Parameter Values

In order to implement our model, we require reasonably reliable measurements of all of the production, demand and mobility parameters described in the previous chapter. We begin with a discussion of consumer demand characteristics.

A. Demand Parameters

As mentioned before, previous empirical studies of general equilibrium tax incidence have been rather weak and uncomfortably arbitrary in their specification of consumer behavior. This weakness has been due in part to the peculiar kind of output aggregation that has been employed, which effectively precludes the use of existing studies of consumer demand. By working with aggregates that correspond to those used in consumer demand studies, we have sought to overcome at least some of this difficulty.

Even if we had access to some reliable empirical estimates of all the requisite price elasticities of demand, we would still lack sufficient information to operate our model. The problem here is that our demand functions require a knowledge of all cross-price, as well as own-price, elasticities. While we could make some educated guesses about the appropriate sizes of the cross-price elasticities from the homogeneity condition, it is not an attractive option. Instead, we prefer to base our estimates on a model of additive utility in consumer demand since the assumptions of this model fit our level of aggregation and because many empirical estimates of complete demand systems use this model as their theoretical foundation. In addition, most of these empirical studies define commodities in approximately the same way as we have. The additivity assumption is most defensible if the consumption categories comprise large aggregates that are dissimilar in nature. It requires that the satisfaction derived from the consumption of, for example, deodorants in our C aggregate be independent of the purchase of pork chops contained in our A aggregate.[21]

Simplicity is an appealing feature of the additivity approach to consumer demand. A complete set of demand parameters can be obtained from a knowledge of the budget shares and income elasticities of each consumer aggregate, plus a parameter defined as the elasticity of the marginal utility of income, which we denote as α.[22] If, as before, we also denote h_i and θ_i as the income elasticity and average budget share of the i'th commodity, all own- and cross-price compensated elasticities take the following form:[23]

$$\text{(a)} \quad \varepsilon_{ii} = \frac{h_i}{\alpha}(1 - \theta_i h_i) \; ; \quad \varepsilon_{ii} \leq 0$$

$$\text{(b)} \quad \varepsilon_{ij} = \frac{-\theta_j h_i h_j}{\alpha} \; ; \quad \varepsilon_{ij} \geq 0$$

All own-price elasticities are appropriately negative, since inferior goods are inadmissible, and are ordinarily smaller than unity.[24] All cross-price elasticities are positive, which means all pairs of commodities are net substitutes for each other (although, if the income effect were added, all commodities would typically be gross complements). The important property of all acceptable demand functions, homogeneity of degree zero in prices and income, is also preserved by this formulation.[25]

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[21] For a discussion of the implications of additivity, see H. Houthakker, "Additive Preferences", Econometrica, April 1960. In particular, inferiority and complementarity are inadmissible but these restrictions pose no problem at our relatively high level of aggregation.

[22] More formally, if μ is the marginal utility of income, I, then, $\alpha = \frac{\partial \mu}{\partial I} \cdot \frac{I}{Y}$ and $\alpha \leq 0$ as $\frac{\partial \mu}{\partial I} \leq 0$.

[23] See Houthakker, op. cit.

[24] In a particular version of the model, the linear expenditure system, all own-price elasticities are restricted to the zero-minus-one range. An application of this system to Canada seeking to measure the excess burden of commodity taxes is found in H. F. Campbell, "Deadweight Loss and Commodity Taxation in Canada", The Canadian Journal of Economics, August 1975.

Scanning the existing empirical literature, we discovered a reasonable degree of uniformity for the estimates of income elasticity that correspond to our consumption aggregates. We briefly review this literature in Appendix C. All these studies indicate that food products, A, are income-inelastic, housing services, H, are slightly income-elastic, while the components of our C and Z aggregates are quite strongly income-elastic. As reasonable point estimates, we have chosen the following income elasticities shown in Table 3-10.

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[25] Homogeneity, or the absence of money illusion, requires that $\varepsilon_{ii} + \sum_{j \neq i} \varepsilon_{ij} = 0 \ \forall i$. Substituting the elasticity expressions above for additive utility, we have $\frac{h_i}{\alpha} \ (1 - \theta_i h_i) - \sum_{j \neq i} (\theta_j h_j) \ \frac{h_i}{\alpha}$.

Since $\sum_{j \neq 1} h_j \theta_j = 1 - \theta_i h_i$ from the budget constraint, we obtain

$$h_{i/\alpha} \ (1 - \theta_i h_i) - h_{i/\alpha} \ (1 - \theta_i h_i) = 0.$$

This may not be a realistic restriction for market demand functions which aggregate individual demands.

Table 3-10

Income Elasticities and Budget Shares

Commodity	A	C	H	Z	M
Elasticity (h_i)	.4	1.1	1.1	1.2	.84
Budget Share (θ_i)	.100	.496	.118	.138	.14

The budget shares are calculated from part II of Table 3-9 to correspond to our initial equilibrium. We have, moreover, combined C and W here to form our inclusive corporate goods sector, and the income elasticity shown is a weighted average of the respective income elasticities. Since savings tend to be a fairly constant fraction of disposable income, we take the income elasticity of W to be one, which, given the budget shares for C and W, implies an income elasticity for C of 1.18. The income elasticity for imports was derived residually from the other estimates by imposing the Engel aggregation restriction, that the share-weighted elasticities sum to one.[26]

Virtually every study known to us has not attempted to estimate demand functions for different income classes. Yet, this is the type of information required by our model. As a result of our assumption of constant income elasticities, the Engel restriction is only approximately satisfied for the various income groups in our economy since expenditure shares, as shown in Table 3-9, vary across different groups.

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[26] Excluding imports of motor vehicles and parts (a relatively recent growth item in imports), Yadav estimates an income elasticity for imports of .944. See G. Yadav "A Quarterly Model of the Canadian Demand for Imports, 1956-72", The Canadian Journal of Economics, August 1975. Truth also compels us to point out that additivity is least likely to be satisfied in the case of imports, many of which compete directly with domestic output in consumer demand.

We could either relax the assumption of constant elasticities in some arbitrary manner or tolerate its consequences. No matter which alternative we adopt, some minor imprecision would appear in our estimates. In order to economize on computation, we have chosen to work with constant elasticities and to accept the very small error that results. Note, moreover, that the elasticities shown in Table 3-10 do not conform to those that are implicit in the cross-section expenditure data shown in Table 3-9. However, the assumption of constant income elasticities does not commit us to assuming invariant, marginal spending patterns for different groups. Marginal consumption propensities for any commodity are the product of the constant income elasticity and the variable average propensities set forth in Table 3-9. Previous studies have frequently attempted to neutralize the effect of redistribution on expenditure patterns by assuming constant marginal, but variable, average consumption propensities. This is a convenient, but hardly realistic, procedure since it implies, in the case of food, for example, that upper-income groups have the largest income elasticity.

For the parameter α, we adopt the value of - 1.55 from Powell's application of the linear expenditure system to Canadian consumption data.[27] This particular value is close to that which has been estimated for other countries and is, in any event, the only published estimate available for Canada. Up to now we have neglected to mention the remaining object of domestic consumer choice in our model: urban transit services. The reason for this neglect is simple: it is such a small fraction of total consumption (less than one per cent) that it can be easily incorporated into Table 3-10 by making very slight adjustments in the reported values. There is not a vast wealth of literature on the demand properties of urban transit services (see Appendix C) but there is convincing evidence that both the price and income elasticities are significantly less than one, with the latter somewhere in the range of .4 to .6. This is the range utilized in this study.

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[27] Alan Powell, "Post-War Consumption in Canada: A First Look at the Aggregates", Canadian Journal of Economics and Political Science, November 1965. Frisch, op. cit., also hypothesized that the absolute value of α increased with higher incomes, but this is a matter of some controversy on which there is little reliable information.

Another demand parameter in our model is the elasticity of foreign demand for flexibly priced exports, E. We have already assumed that about 16 per cent of Canada's exports, mainly agricultural, face a perfectly elastic foreign demand. We must now consider the demand characteristics for the remainder of Canadian exports. Foreign demand for Canada's exports is affected both by the responsiveness of foreign consumers to price changes and by the reactions of foreign suppliers that compete with Canadian exporters.[28] If foreign suppliers respond vigorously to changes in world price levels, Canada's share of the world market will fluctuate markedly and her foreign demand price elasticity will tend to be elastic, especially in those products where she is not the dominant world supplier. Using econometric estimates of foreign demand elasticities for Canada's major resource exports, newsprint, woodpulp, nickel, iron ore and copper, along with assumed values for the foreign supply elasticity, Detomasi has recently calculated a weighted average price elasticity of demand for these exports to the U.S. market.[29] If long-run supply elasticities are taken to fall in the range of 2 to 5, the demand price elasticity for Canadian exports falls in the interval of -5 to -10. Whether we should apply this range to the rest of the export bundle contained in E, primarily manufactured exports that have a heavy natural resource content, is debatable, but we are not aware of any empirical evidence which would convincingly argue otherwise.[30] We, therefore, experiment with a range of -1 to -6 for the foreign demand parameter.

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[28] Canadian exports E are the difference between foreign demand (D) and foreign supply (S). Differentiating the relationship $E = D - S$ with respect to price results in $\eta = \frac{D}{E} \varepsilon_f - \frac{S}{E} \delta_f$, where η is the price elasticity of Canadian export demand and ε_f, δ_f denote, respectively, the foreign demand and supply elasticities.

Had it been feasible, we would have preferred to define the sectors E and F as exportables instead of simply as exports. Many products which are exported are also consumed domestically either as final goods or as intermediate inputs in the production of final goods. Ideally, we would have liked to have been able to partition the corporate output sector C into exportable and nonexportable components. Then, for example, a higher world price for exports would have the effect of dampening the domestic demand for exportables directly.

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[29] D. D. Detomasi, "The Elasticity of Demand for Canadian Exports to the United States", The Canadian Journal of Economics, Vol. 2, No. 3, August 1969.

[30] Many Canadian exports are of a contractual nature, for example, uranium, electricity, and products sold under the Defense Production Sharing Agreement and the Auto Pact. Within limits, Canada can sell its exportable surplus of these goods at the negotiated price. This fact argues for an elastic foreign demand for exports.

Working with just exports, our model does not contain this demand linkage, except indirectly to the extent that higher world prices for exports boost domestic factor prices. The reason for our inability to disaggregate the C sector in this fashion is that many export items are of an intermediate nature while all of our outputs are defined in terms of final commodities. Thus, we cannot identify in any satisfactory way how sales of intermediate exports are linked to the domestic purchases of domestically produced final output. This may be viewed as the price we pay for our choice of aggregation, but we believe it is a small price to pay for the other advantages that are achieved as a result of this choice. Only a much more complicated model, one which recognized intermediate outputs explicitly, could overcome this limitation of ours.

In order to keep the computational burden of our model manageable, we operate it with three distinct income groups. These consist of a lower income group earning between zero and four thousand dollars, a middle income class earning between four and ten thousand dollars annually and an upper income group receiving more than ten thousand dollars in annual income. These groups constitute about 28, 45, and 27 per cent, respectively, of the total population of income earners. However, in our calculations of the redistributive effects of various fiscal experiments, we work with all twelve of the income classes described previously.

B. Factor Substitution Parameters

Because of our assumption of constant returns to scale in each production sector, the elasticity of factor substitution in the production of final output becomes a weighted average of the sectoral (one-digit) elasticities, where the weights are given by the share of value-added in each output, as shown in Table 3-1. From a wide array of empirical studies, also briefly reviewed in Appendix C, we have settled on the following ranges for the sectoral elasticities:

Table 3-11

Factor Substitution Elasticities by Sector

	σKN	σKL	σNL
Agriculture	1 - 1.5	0 - .2	.6 - 1
Forestry	.4 - .8	-	-
Mining	1.5	-	-
Construction	1 - 1.5	-	-
Manufacturing	.5 - 1	-	-
Transport, et al	.1 - .3	-	-
Wholesale Trade	.8 - 1	-	-
Retail Trade	.8 - 1	-	-
Finance	.5 - .8	-	-
Real Estate	.1 - .2	.5 - 1	0 - .1
Owner-occupied Dwellings	0 - .1	.5 - 1	0 - .1
Commercial Services	.2 - .4	-	-

Applying the sectoral weights in Table 3-1 to these values, gives us the factor substitution ranges for our final commodities in Table 3-12 below:

Table 3-12

Factor Substitution Elasticities for Outputs

Parameter Output	A	F	E	Z	H	C	T	G
σKN	.75-1.2	.85-1.3	.7-1.1	.3-.6	.1- .24	.6-1.1	.5-1	.8-1
σKL	0 - .2	0 - .2	-	-	.5-1	-	-	-
σNL	.6 -1	.6-1	-	-	0 - .1	-	-	-

Although we do not have explicit estimates for the ease of factor substitution between capital and labor in the production of urban transit and local government services, we feel the range given above is a reasonable one in view of the relatively labor intensive nature of these activities. For these activities, we estimate the share of labor to be in the neighborhood of .75-.8 for urban transit and close to one for local public services, higher than that for most private sector activities.[31]

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[31] Because most government services are not marketed, the returns to public sector capital are unknown. We have no information on the size of the capital stock employed in the public sector so we assume its income share is a negligible magnitude. While it is consistent with national accounts conventions, this assumption could lead to upward bias in measuring the labor intensity of government services.

C. Factor Mobility Parameters

Among the more elusive parameters to pin down in our model are those which describe the domestic mobility of labor and capital and the international mobility of capital. As in previous cases, we have attempted to let the available empirical literature guide our judgement in this matter. Consider first the question of labor's spatial mobility. Our model specifies a mobility relationship of the following form (equation (81), p. 64, appears in the differential equation guise as): $\hat{N}^p - \hat{N}^r = \gamma_N (\hat{P}_N^p - \hat{P}_N^r)$

As was indicated in the previous chapter, the difference in relative regional wages refers to percentage changes in the real wage earned by labor. Unlike capitalists and landowners, workers ordinarily must consume at the location where their services are rendered. Only if workers everywhere had the same tastes, and destination sales taxes were equal in every region, would it be legitimate to ignore regional product prices in the migration equation. In general, the percentage change in labor's real wage is given by: $\hat{P}_N^i - \sum_{j=1}^{6} \theta^i_{N_j} \hat{P}^*_j$, where $\theta^i_{N_j}$ denotes the share of the worker's budget spent on the j'th consumer good in the i'th region. This expression would be even more complicated if labor, at different income levels, has different budget shares. We skirt this difficulty by assuming that the average budget share for the region is applicable to all labor.

If M_{ij} represents labor migration from the j'th to the i'th area, and given that $dN_i = -dN_j = M_{ij}$, the previous equation can be rewritten to appear as $\frac{M_{ij}}{N_i} \left(\frac{N_j + N_i}{N_j}\right) = \gamma_N \left(\hat{P}_N^i - \hat{P}_N^j \right)$.

Now equations having approximately this form have been econometrically estimated in the case of Canada by Courchene.[32] Using both census and Family Allowance data, he obtained regression estimates of the responsiveness of interprovincial migration to differences in provincial wage incomes and other variables, including relative unemployment rates. In both linear and log-linear form, he found that, for the working-age population, the elasticity of interprovincial migration, as a fraction of the population in the sending region with respect to relative wage rates, was of the order of 3.5.[33] This elasticity measure is independent of the relative size of the population in the receiving region, whereas our mobility parameter, γ_N, is not. To make the empirical elasticity compatible with our theoretical construct, we impose the condition that $(\frac{N_j}{N_i + N_j}) \gamma_N = 3.5$. Thus, for example, if a region had one-tenth the population of another, $\gamma_N = 3.85$ and this value would be the appropriate one for the specification we use in our model. The simulation experiments utilize a range of values, two to five, which bracket the value of this point estimate.

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[32] T. J. Courchene, "Interprovincial Migration and Economic Adjustment", The Canadian Journal of Economics, November 1970. In Courchene's specification, the variables are not scaled by the population factor $\frac{(N_i + N_j)}{N_i}$ as shown above.

An intriguing theoretical issue emerges from the comparison of Courchene's regression specification with our mobility relationship which relates the relative size of regional work forces to changes in the relative regional real wage rate. Courchene, however, makes migration between regions a function of relative regional wage levels. This relation has unattractive dynamic properties for it implies migration will continue indefinitely until a low wage region is entirely emptied of its labor force. We can still use his empirical findings, however, if we make the assumption that all of the adjustment to a wage gap occurs within a single year.

[33] This result must be qualified in light of Courchene's discovery that wage changes in the receiving region exerted a stronger effect than wage changes in the sending region, that is, the single mobility parameter is to some extent an improper specification. Moreover, the value of a parameter no doubt varies from region-to-region, as in the case of Quebec, where there are strong cultural barriers to out-migration.

We are less fortunate in being able to obtain reliable estimates of the mobility of domestic capital. Presumably, profit-maximizing capitalists are indifferent to the geographic site where their capital is used, so that the elasticity of the desired capital stock in a region with a favorable rate of return is probably very high.[34] However, given any rate of return differential, the ease with which capital can be relocated is limited by the speed of depreciation of existing capital goods and by the ability to physically transport them to alternative sites. Though we cannot fully substantiate this choice, we feel that a reasonable range for the capital mobility parameter may be between 3 and, perhaps 10. Capital, we believe, is less immobile than labor in the long run.

On the question of capital's international mobility, we can be assured that the elasticity is less than infinite for we would otherwise observe dramatic fluctuations in the flow of direct investment in response to small changes in the factors which affect capital's rate of return. Numerous imperfections, including the existence of monopoly rents that are protected by entry barriers and inaccurate perceptions of future economic trends, serve to constrain capital's international mobility. A study by Murray helps to shed some light on this matter.[35] Although he does not estimate an elasticity coefficient directly, he does simulate the reactions of foreign direct investment to alternative tax regimes. By comparing the ratios of gross returns to capital under these different regimes, we derived an arc elasticity in the range of .5 to 1.5 from his work. We, therefore, experiment with a value of .5 to 3 for this important parameter.

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[34] The fear of expropriation is unlikely to be a relevant consideration in the decision of where to invest although there may be special cases, as in the situation of Quebec, where some concern about separatist intentions may exist.

We have no direct information on land mobility but, since a large amount of agricultural land lies outside municipal boundaries, we use a low range of elasticity values, .2 to .9, in our simulations. To see the rationale for this choice, notice that, since the total supply of municipal land is given, the supply elasticity of land to housing is proportional to the negative of the demand elasticity for land in agriculture. The latter elasticity is given by $\hat{L}_A / \hat{P}^A_L = \theta^A_L (\epsilon_{AA} - \sigma^A_{LL})$, where ϵ_{AA} is the final demand price elasticity, θ^A_L is the income share of land in the production of A, and σ^A_{LL} is the partial elasticity of factor substitution for land. Since $dL_A = - dL_H$, the supply elasticity of land to the housing sector becomes $\hat{L}_H / \hat{P}^A_L = \theta^A_L (\epsilon_{AA} - {}^{A}_{LL}) L_A / L_H$. We ignore agricultural exports here since it is our casual impression that most of the agricultural pursuits, such as dairying, found in a typical urban municipality have a relatively high land productivity and as such can afford to pay the land rents needed to reserve land from housing.

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[35] John D. Murray, "Tax Differentials and Foreign Direct Investment Flows: The Canadian-United States Experience", Mimeo, University of British Columbia, 1976. A more recent study suggests that a one per cent change in foreign rates of corporate taxation will produce a 2.86 per cent decline in the volume of U.S. foreign investment. See D. G. Hartman, "Deferral of Taxes on Foreign Source Income", National Tax Journal, Vol. 30, No. 4, December 1977.

Information on the sensitivity of financial flows to interest rate changes does not help to establish the degree of capital's physical mobility. To a large extent, observed financial flows reflect portfolio (wealth) realignments that are not directly related to either current or future flows of real investment and the issuance of new financial assets.

By analogy with the previous mobility equation for labor, we can write the mobility relationship for land as $\hat{L}_H = (\frac{L_A}{L_A - L_H}) \gamma_L (\hat{P}^H_L - \hat{P}^A_L)$.

Comparing this expression for $\hat{L}_H$ with the one above, it is easily seen that $\gamma_L (\frac{L_A + L_H}{L_H}) = \theta^A_L (\epsilon_{AA} - \sigma^A_{LL}) \frac{L_A}{L_H}$.

$\gamma_L = (\frac{L_A + L_H}{L_H}) = \theta^A_L (\epsilon_{AA} - \sigma^A_{LL})$. On the basis of this expression for γ_L, a likely range for its value can be established. Almost all the evidence with which we are familiar suggests that dairying, truck gardening and the like face inelastic final demand conditions and that, for a given technology, there are few close substitutes for land. For the sake of agrument, if $(\epsilon_{AA} - \overset{A}{\sigma LL}) = 1$ and $\theta^A_L = .3$ and no more than 20 per cent of municipal land is devoted to agriculture, the implied range of estimates for γ_L is between .3 and .4. A value smaller than unity appears to be justified in any case.

D. The Municipal Budget Structure

In our federal revenue-sharing experiments we are concerned with changes in the overall municipal budget for Canada in 1969. We must, therefore, disaggregate the earlier, total government account to enable us to work with a consolidated federal-municipal government budget. In Table 3-13 we present the composition of expenditures and revenues for all Canadian municipalities in 1969. Slightly more than half of total expenditures were devoted to education, while slightly less than half of all revenues were derived from real property taxes. About 3 per cent of all expenditures were directed to social welfare purposes.

To obtain the dimensions of the local government sector, we decided to ignore debt financing, since it is relatively unimportant and plays no role in our model, and, thus, to restrict total spending to the amount of total revenue, \$6,712 mn. Of this amount, welfare expenditures then represent approximately \$200 mn. The magnitude of our other expenditure instrument, urban transit services, is a more difficult item to establish. As a conservative estimate, we assume \$300 mn. was spent on these services in 1969.[36] We also assume that this system operates with the aid of an initial 3 per cent subsidy which covers the transit deficit. Thus, expenditures on urban transit are taken to

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[36] Family Expenditure in Canada indicates that about \$222 mn. was spent by all families on item 820, street car, bus, commuting bus or train. Even allowing for subsidized operation, this figure appears to be a substantial underestimate of the nationwide total. For example, the annual report of the Toronto Transit Commission lists total revenues of \$76.8 mn. in 1969 or about one-third of the total from the Expenditure Survey. The Statistics Canada publication, Urban Transit, No. 53-216, lists total operating expenses of all transit systems in Canada as \$256 mn. in 1969. Since this figure ignores net capital cost, we adjust it upwards to \$300 mn.

Table 3-13

Municipal Budget Structure, 1969

(millions)

Revenue

Real property, personal property, business and poll taxes	$3,048 mn.
Transfers from other governments	$2,806 mn.
Other	$ 858 mn.
Gross General Revenue	$6,712 mn.

Expenditures

Gross General Expenditure	$7,268 mn.

Per cent spent on:

General Services	4.3
Protection	7.2
Public Works	12
Sanitation and Water	7.2
Health	2
Social Welfare	2.9
Community Services	3.6
Education	50.7
Debt Charges	6.4
Other	3.4
	100

Source: Local Government Finance, Revenue and Expenditure, Preliminary Estimates, Statistics Canada, No. 68-203.

represent about .5 per cent of disposable income and about 4.47 per cent of municipal expenditures. The remainder of municipal expenditures we lump into a single, polyglot, expenditure category which we have called G, the production of non-marketed local public services.[37] Spending on this aggregate output is, therefore, taken to be $6,212 mn., initially.

On the revenue side, we divide property tax payments between housing (owner-occupied and rental) and non-residential capital in the proportion two-thirds to one-third.[38] Within the housing sector, we further attribute one-quarter of the residential property taxes to land and the rest to residential capital in accordance with the approximate value shares of these two factors. For the agriculturally intensive commodities A and F, we assign two-thirds of total agricultural property tax payments to land and the remaining fraction to capital.[39]

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[37] Ideally, of course, one would, for example, like to be able to distinguish between educational, fire and police services and the services of municipal golf courses or tennis courts since different income groups benefit to varying degrees from expenditures on these separate items. To properly assign benefits, one would need to know two types of information: the extent of use by income class, and the spatial distribution of any change in these expenditures. With these data, one could determine, for example, the value of crimes prevented by income group and whether extra police are assigned to patrol rich or poor neighborhoods -- assuming that the benefits from these services decline as the distance from their site of provision increases.

[38] This is the division suggested in Jenkins's study, op. cit., and which also coincides with the allocation in Maslove's study, op. cit., p. 58.

[39] As with the previous property tax allocation, this one also agrees with Maslove, op. cit., p. 58.

In a model with initial taxes, the alteration of a single tax rate will ordinarily change the level of tax revenues from all sources. We allow for this contingency in our model by making the assumption that any induced change in total revenues will lead to a proportional expansion in all government expenditure categories. This is the simplest, and probably the most reasonable, assumption that could be made.

Another problem caused by the existence of initial taxes is the need to know how changes in statutory tax rates translate into changes in effective tax rates for different activities. In analyzing the impact of removing entirely an existing tax or introducing a new one, this issue would not arise. However, in the context of our fiscal experiments, we cannot avoid coming to grips with it. The most straightforward, but still imperfect, method of handling this problem is to weight the statutory tax change by the fraction of the tax base which is included in the composition of each commodity. In the case of the corporate income tax, for example, if all the capital used in the production of a commodity were liable to the tax, we would assume that the change in the effective corporate rate equals the change in the statutory rate. But, if only half of the capital in that activity were subject to the tax, we would assume that the effective rate changed by only one-half of the statutory change. Thus, for example, from Table 3-2 it can be inferred that a 10 per cent change in the corporate tax rate will generate a 2.6 percentage change in the effective tax rate on corporate output and a smaller change of 1.4 per cent in the production of A. We treat statutory changes in property tax rates in a parallel manner and employ the same method to determine effective rate changes for sales taxes. If 25 per cent of the output encompassed in one of our aggregates is exempt from the sales tax, we assume that the effective rate change is only three-quarters of the change in the statutory rate. For the personal income tax, we assume that the rates of each income group are adjusted by the same percentage amounts so that effective rate differentials remain unchanged.

E. Provincial Municipalities and Provincial Trading Patterns

In our provincial revenue-sharing experiments we deal with two domestic regions and a consolidated provincial-municipal budget. For a particular provincial jurisdiction, the overall government budget changes to reflect alterations in the province's personal and corporate income taxes that are counterbalanced by tax and expenditure changes at the municipal level of the province.

Information on the structure of provincial economies is especially difficult to obtain since systematic efforts to compile such data have never been made. What information is available is fragmentary and not wholly consistent. In view of this weakness in the provincial numbers, our measurements of many variables should be interpreted as orders of magnitude rather than precise estimates. Some of the provincial data that we have been able to assemble for our purposes is shown in Table 3-14. Nova Scotia is taken to be representative of the Atlantic provinces.

Table 3-14

Structure of the Provincial Economies
(millions)

	Province						
Production	British Columbia	Alberta	Saskat-chewan	Manitoba	Ontario	Quebec	Nova Scotia
A	641	451	264.4	284.7	2,557	1,900	211
H	728	496	280	323	2,900	1,775	239
Z	541	395	189	227.7	2,180	1,401	137
C	954	934	513	615	5,850	3,503	404
E	1,631	600	50	100	4,212	2,219	211
F	-	130	200	150	788	581	-
E + F	1,631	730	250	250	5,000	2,800	211
G	700	600	285	300	2,911	1,712	184
T	25	18	6	18	125	95	4
W	1,462	1,232	598	575	4,238	2,383	454
Expenditures							
C	2,026	1,434	663	765	7,550	4,554	530
M (from rest of Canada)	1,072	500	150	150	-	-	97
M (from rest of world)	559	230	100	100	6,200	3,498	87
Exports of C	-	-	-	-	1,200	672	-
Real Property Taxes	301	211	140	123	1,217	684	62

Sources: Local Government Finance, Statistics Canada, No. 68-203; Family Expenditure in Canada, Statistics Canada, No. 62-535; Private and Public Investment in Canada, Outlook 1969, Statistics Canada, No. 61-205.

The methodology by which these numbers were constructed requires some explanation. A few of the categories are extracted directly from Statistics Canada publications. These include the data on the expenditure magnitudes for local government services, G, municipal welfare, urban transit, T, and real property taxes.[40] The other categories are constructed on the basis of some specific assumptions about regional trade patterns. Since we assume that the outputs H and Z are nontradeable, we measure the value of their production and consumption as the amount of total provincial expenditure contained in the Family Expenditure Survey. The output of A is also nonexportable but, unlike the services H and Z, faces competition from foreign agricultural goods. Total agricultural imports in 1969 amounted to $1,246 mn., or about 16 per cent of final expenditures by consumers. From the Expenditure Survey, we obtain total provincial spending on A and take 84 per cent of this amount as the domestic production of A in each province.

Exports are allocated to provinces on the following basis: 17 per cent of total export value to British Columbia, 6.7 per cent to Alberta, 2.3 per cent to each of Saskatchewan and Manitoba, 46 per cent to Ontario, 26.5 per cent to Quebec and 1.9 per cent to Nova Scotia. An Ontario government publication is our source for this allocation.[41]

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[40] We measure G as the sum of gross municipal expenditures in each province. All of the items, except urban transit, have, as their source, the Statistics Canada publication, Local Government Finance, Revenue and Expenditure, Preliminary Estimates, No. 68-203. Transit data are drawn from Urban Transit, No. 53-216.

[41] Ontario Ministry of Treasury, Economics and Intergovernmental Affairs, Trade Patterns in Canada and Ontario, 15th Annual Premiers' Conference, September 12-13, 1974, p. 10.

We then rather arbitrarily segregate exports into the E and F varieties, based on our casual knowledge of the importance of agriculture in each province. The total amounts of E and F for all provinces are also constrained to add up to the national sums for E and F, $9,023 mn. in the case of E and $1,849 mn. for F.[42]

The most difficult determinations involve estimates of the production of corporate output C in each province. Since C is the interregionally traded commodity in our model, we must establish both the direction and the size of these unmeasured trade flows in order to obtain a consistent relationship between the provincial consumption of C as recorded in the Expenditure Survey and the provincial production of C. Our working hypothesis is that regional trade flows follow a triangular pattern. From the industrial heartland of the country, Ontario and Quebec export C output to the other provinces which pay for their domestic trade deficit with an external trade surplus. Numerous studies, including our own, support this notion. A recent examination of British Columbia's trade concludes that it "exports industrial raw materials to the world to pay for imports of manufactured goods from the rest of Canada."[43] A similar pattern undoubtedly holds for the Prairie provinces, which export a combination of agricultural and industrial raw materials to pay for imports of finished goods from the rest of Canada and the rest of the world. Nova Scotia also, most likely, falls into the same mold.

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[42] These values are inclusive of indirect taxes but net of imports used in export production.

[43] R. A. Shearer, J. H. Young and G. R. Munro, Trade Liberalization and a Regional Economy: Studies of the Impact of Free Trade on British Columbia, Toronto: University of Toronto Press, 1971, p. 29. In 1963 it is estimated that B. C. ran a surplus with the rest of the world of $650 mn., matched by a deficit with the rest of Canada of $550 mn.

We made a partial check of this assumption by comparing provincial estimates of value-added in manufacturing with the amount of manufacturing value-added needed to satisfy actual provincial spending on C, A, H and Z. For the latter calculation, we used the manufacturing, value-added weights given in Table 3-1 for each of the various final commodities. As expected, the consumption of manufacturing value-added was substantially larger than the amount produced for the Prairie provinces and Nova Scotia, while the reverse was true for Ontario and Quebec. For B.C. there was a rough balance between the two, but we know that much of the manufacturing value-added produced in that province is sold abroad in the form of pulp and paper and other natural resource exports.

Given this postulated direction of trade in C, we estimate the size of C production in each province, and, by implication, the extent of interregional trade in C, by imposing the provincial balance of payments constraint. For the provinces importing C from the rest of Canada, the sum of their external exports must balance the value of imports of C from Ontario and Quebec and imports from the rest of the world. From the assumed distribution of the latter shown in Table 3-15, we estimate the production of C as the difference between total expenditures of C and the gap between total exports and imports from the rest of the world. This procedure lends some upward bias to the estimate of provincial C output since it ignores imports of C-type output from the rest of the world. We know of no information which would allow us to correct for this bias. Examining Table 3-14, we see that this procedure suggests that about $1,872 mn. of C output is exported from Ontario and Quebec to the other provinces.[44]

For Ontario and Quebec we require that their exports to the world and the rest of Canada match their imports from foreign countries. Based on their external trade ratios, we assume that Quebec's exports to the rest of Canada are 60 per cent of those for Ontario. Of the $1,872 mn. in Quebec-Ontario exports, $1,200 mn. thus originates in Ontario and $667 mn. in Quebec. Thus, total exports (and total imports) are calculated as $6,800 mn. in Ontario if Ontario also sells an assumed $600 mn. of C to Quebec. Again, we have no data on the composition of imports into these regions, we thus make the assumption that $3,100 mn. of total Ontario imports are of the C variety, and calculate production of C output as total expenditures on C, less foreign imports of C, plus exports of C to the rest of Canada. We have, therefore, for Ontario, production of C as $7,550 - $3,100 + $1,800 = $6,250 mn.

Although the preceding set of numbers are little more than well-aimed shots in the dark, the errors they contain will not seriously distort the operation of our model. In a model that contains as many coefficients as ours does, the impact of a 10 or 20 per cent error in the measurement of C production for instance, will be imperceptible. What is of greater importance for the results of our model is the way in which we have structured interregional trade flows. We do some violence to reality by restricting interprovincial trade to occur only in C goods. Some trade flows also occur for A which we have ignored.[45] We have already imposed a powerful constraint on our model by requiring that the price level of the aggregate output C be the same in both regions. If we afforded the same treatment to our aggregate A and permitted it to be interregionally traded, while E and F were internationally traded, we would have four price equations for C, A, F, and E which would solve for all of our factor prices--no other equations in the model would be necessary. To avoid this degeneracy in our model, we have stipulated that A be locally produced and locally consumed. Only a larger, more disaggregated, and, hence, more complex model, which incorporated more factors of production, could satisfactorily handle this problem. However, as will be seen in Chapter 6, despite our awareness of this problem, we have not been entirely successful in avoiding it.

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[44] *In the Ontario Economic Review*, Vol. 9, No. 5, September 1971, total Ontario exports for 1969 are estimated as $9,318 mn. For the same year, Ontario exports to foreign countries are estimated as $6,815 mn, in footnote 43 of the document cited. Thus, Ontario exports to the rest of Canada may have been $2.4 mn. in 1969. If half of this amount were sold in provinces outside Quebec and Quebec's exports to all of Canada besides Ontario were 60 per cent of the latter value, we would have a combined Ontario-Quebec sum of export sales to the other provinces that is close to $1,872 mn.

Our provincial revenue-sharing experiments utilize the data in Table 3-14. In moving from one province to another, we subtract the provincial data from the appropriate national totals to form our rest-of-Canada region. We further break down the production values into factor shares and factor employments using the national coefficients presented earlier. From this exercise we obtain total payments to capital, labor and land in each province, which is then combined with provincial distributive series to form a size distribution of income for each province in the same way as before.[46] The same range of parameter values and expenditure coefficients for income classes are employed as in the federal revenue-sharing experiments. We then alter our provincial and municipal tax and expenditure instruments according to the nature of the experiment, and measure the induced changes in the size distribution of income that occur in both regions of the economy. Appendix D sets forth a detailed derivation of the various provincial series. We reserve discussion of the details of these particular manipulations of the data until Chapter 6 where we give our provincial revenue-sharing results. But, first of all, we discuss benefit incidence and, after that, consider the results of our federal revenue-sharing experiments in the following chapter.

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[45] Portage La Prairie, for example, supplies a well-known brand of soup products over a market area from British Columbia to Ontario. Then, of course, there are Prince Edward Island's potatoes which enjoy a national market.

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[46] Again, we rely on the distributive series for each province that are contained in Maslove, op. cit.

Chapter 4

A Synthesis of Different Approaches to Benefit Incidence

PART I: Introduction*

In the previous chapters we have devoted almost all our attention to the issues of tax and expenditure incidence. Here we try to correct this imbalance by considering the important question of benefit incidence.

In the past decade, there has been increasing interest in the allocation of income equivalents for the benefits derived from public expenditures.[1] This interest has grown from an increasing concern for the potential redistribution involved in government expenditures. Since Samuelson's seminal contributions to the analysis of public goods in the early 1950s, economists have attempted to redress the previously unbalanced attention to the taxation side of the budget.[2] Despite the early, rigorous formulation of the theory, the application of public goods theory to benefits incidence has been slow. Only in recent years has the synthesis of theory and application begun, and few practitioners would not claim that much work remains to be done.[3]

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* This chapter is an edited and slightly modified version of a paper written by James M. Dean of the University of Manitoba. He should receive most of the credit for the ideas presented in this portion of our work.

[1] See, for example, W. Irwin Gillespie, "The Effect of Public Expenditures on the Distribution of Income", in Richard A. Musgrave (ed.), Essays in Fiscal Federalism, Washington: The Brookings Institution, 1965; W. Irwin Gillespie, The Incidence of Taxes and Public Expenditures in the Canadian Economy, Staff Study No. 2 of the Royal Commission on Taxation, Ottawa: Queen's Printer, 1966; James A. Johnson, The Incidence of Government Revenues and Expenditures, Toronto: (Queen's Printer, 1967); Tax Burdens and Benefits of Government Expenditures by Income Class, 1961 and 1965, New York: Tax Foundation, Inc., 1967. See also, W. Irwin Gillespie, "The Incidence of Government Expenditures: The Effect of Government Expenditures on the Distribution of Income", mimeographed, Ottawa, 1975.

[2] P. A. Samuelson, "The Pure Theory of Public Expenditure", The Review of Economics and Statistics, 1954, pp. 387-89; "Diagrammatic Exposition of a Theory of Public Expenditure", The Review of Economics and Statistics, 1955, pp. 350-56; and "Aspects of Public Expenditure Theories", The Review of Economics and Statistics, 1958, pp. 332-38.

The issue is an important one for all levels of government. Progressivity in the tax structure indicates that the distribution of income is being made more egalitarian. However, when it is recognized that the tax revenues may well finance a differential quantity of services to different income classes, it can be seen that examining the tax structure alone is inadequate.

This chapter will examine the basis for allocating benefits from all municipal expenditures, and two services in particular, welfare payments and public transit. To do this, it is first necessary to consider alternative approaches to benefit incidence. It will be shown that each of these approaches can be related to a common, general framework. Using this framework facilitates discussion of the two expenditure instruments included in our model.

PART II: Alternative Approaches to Benefit Incidence

A. A Brief Overview

Historically, the allocation of government expenditure benefits among income classes began with reasonable assumptions by the investigator as to the allocation of benefits. This approach was adopted by researchers doing benefit incidence studies for both the United States and Canada. Gillespie's approach is typical of this method of benefit allocation.[4] In the simplest case, where both purely private and purely public goods are provided by government, the benefits can be allocated in the following way. Benefits from private goods, which provide benefits to clearly demarcated groups, are estimated as the cost of providing the private good and are fully allocated to the benefiting group. However, the benefits from public goods are less easily allocated. Several reasonable assumptions are made as to the way these benefits might be distributed. Benefits are assumed to be distributed proportionately either to families, total income, capital income, or disposable income. Using each of these assumptions, empirical estimates are generated. Unfortunately, the results are extremely sensitive to the assumption made, ranging from regressive, when an allocation by families is used, to proportional, when total income is used, and to progressive, when capital income is used.

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[3] See Henry Aaron and Martin C. McGuire, "Public Goods and Income Distribution", Econometrica, Vol. 38, No. 6, November 1970, pp. 907-20; Shlomo Maital, "Public Goods and Income Distribution: Some Further Results", Econometrica, Vol. 41, No. 3, 1973, pp. 561-68; Kenneth Greene, William G. Neenan and Claudia D. Scott, Fiscal Interactions in a Metropolitan Area, Lexington, Mass.: D. C. Heath and Company, 1974 and Shlomo Maital, "Apportionment of Public Goods Benefits to Individuals", Public Finance, November 1975, pp. 397-416.

A rationale can be found for each assumption. However, the sensitivity of the final results increases the importance of finding out which assumption is most reasonable. Neoclassical economics is useful here. A utility function can be postulated for an individual and reasonable restrictions placed on it. If these assumptions can be supported, implications for the distribution of benefits can be derived.

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[4] W. Irwin Gillespie, op. cit., (1965, 1966, 1975).

Some work has been done on deriving the implied benefit incidence from assumptions about the underlying utility function. This approach was developed by Aaron and McGuire and has been considered by a number of writers.[5] Two of the assumptions which are crucial to deriving a benefit allocation rule independence between public and private goods and a Lindahl pricing rule, will be considered in more depth in a later section.[6] It is sufficient, here, to note that Aaron and McGuire derive the rule that benefits can be allocated among classes in inverse proportion to the marginal utility of income. On close examination, this rule is based neither upon interpersonal comparisons of utility nor upon an inestimable magnitude. With the appropriate information, this rule has been used to show that benefits are either proportional to disposable income or slightly progressive.[7] Differences in these results are due primarily to disagreement over the empirical magnitude of the elasticity of the marginal utility of income. This general methodology is a substantial improvement over the earlier ad hoc assumptions approach, since the disagreements can be settled by appropriate, empirical research.

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[5] H. Aaron and M. C. McGuire, op. cit. See also S. Maital, op. cit. (1973, 1975) and C. E. McLure Jr., "Public Goods and Income Distribution: An Explanatory Comment", Discussion Paper No. 49, Rice University, 1974.

[6] The assumptions made by Aaron and McGuire are: a) utility functions are identical for all persons; b) public goods enter all utility functions; c) all households in an income class can be represented by the average, income-level and expenditure mix in that bracket; d) output of public goods is efficient; e) the utility function is separable; f) public goods are produced under constant costs; g) there is perfect information.

[7] K. V. Greene, W. B. Neenan and C. D. Scott, op. cit., and S. Maital, op. cit., (1973, 1975).

A third approach is possible. In the literature on empirical estimates of the determinants of public expenditures, and the demand for public goods, elasticity estimates for price and income are available.[8] Neenan, in reviewing some of these studies, cited estimates of the income elasticity of demand as supporting the position that benefits are approximately proportional to income.

The common thread linking all three of these approaches will be demonstrated subsequently. It is possible to adopt the Aaron and McGuire methodology and utilize data on the elasticities of demand as a substitute for data on the elasticity of the marginal utility of income. Finally, the ad hoc assumptions discussed earlier will be shown to be consistent with the Aaron and McGuire methodology. We will begin by establishing the framework to be used.

B. Theoretical Reconciliation

1. The Aaron and McGuire Approach

Aaron and McGuire begin with an individual utility function containing the services of both private and public goods.[9]

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[8] See William B. Neenan, Political Economy of Urban Areas, (Chicago: Markham Publishing Company, 1972), p. 107 and the references contained therein. See also, R. Barlow, "Efficiency Aspects of Local School Finance", Journal of Political Economy, Vol. 78, No. 5, (1970), pp. 1028-40; Thomas E. Borcherding and Robert T. Deacon, "The Demand for the Services of Non-Federal Governments", American Economic Review, Vol. 62, No. 3, June 1972, pp. 891-901; and Theodore C. Bergstrom and Robert P. Goodman, "Private Demands for Public Goods", American Economic Review, Vol. 63, No. 3, 1973, pp. 280-96.

[9] Henry Aaron and Martin C. McGuire, "Public Goods and Income Distribution", Econometrica, Vol. 38, No. 6, (1970), pp. 907-20.

(1) $U^K = U^K (X_i, G)$

where U^K = the utility of individual K ($K = 1 \ldots N$)

X_i = private good i ($i = 1 \ldots n$)

G = public good

To calculate an income-equivalent measure of benefit, several assumptions are made, including the assumption that the utility function is applicable to all income classes and that the utility function is separable. Separability need not be as restrictive as was initially thought. If the public sector is considered as a whole, then it is difficult to say if the marginal utility of public goods is affected by a change in the consumption of private goods. Some public activities are substitutes for private goods and some are complements, so independence may be "not unreasonable" for all public goods. However, this lack of information is more important when the benefits from particular public goods are to be allocated across income classes. Considering transfers, substitutability or complementarity is hard to establish, so independence may again be considered "not unreasonable". The separable utility function may now be rewritten as:

(2) $U^K = U^K (X_i) + U^K (G)$

In the private market, an individual will equate the marginal rate of substitution between private goods (MRS) with the prevailing relative price ratio. Since all individuals face the same relative price ratio, MRS may be used as an indicator of the value the consumer places on the good at the margin. Aaron and McGuire suggest that the MRS may also be used as an indicator of the value, at the margin, of a specified quantity of public good. This value may be applied to all units to yield the equivalent, for the public sector, of uniform pricing in the private sector.

For all individuals, the Lindahl market analogue pricing rule suggests that benefits per person may be determined as:[10]

(3) $MRS^{K} \cdot G$

Assuming the public good is supplied efficiently, the optimum conditions are:

(4) $\sum_{K} MRS^{K} = MC$ $(K = 1 \ldots N)$

(MC = marginal cost of production)

Assuming constant production costs, total benefits provided will be just equal to the total cost of providing the public good.

(5) $\sum_{K} MRS^{K} G = MC_{G} \cdot G$ (where MC of the private good is defined to be unity)

The marginal rate of substitution between the public good and income spent on private goods can be rewritten as the ratio of marginal utilities of each good.

(6) $MRS^{K} = MU_{G}/MU_{Y}$

As we noted, separability implies that the marginal utility of the public good will be unaffected by increases in consumption of private goods. In this case, MU_{G} is constant ($\bar{c}$) when the quantity of public good is constant. For a pure public good, the same quantity of public good is consumed by all individuals. It is now possible to substitute equation (6) into equation (5) and rewrite it as:

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[10] Note that this pricing rule ignores consumer surplus from public goods. This is analogous to the treatment of consumer surplus when only private goods are considered.

$$(7)\quad \sum_{K} \frac{\bar{c}}{MU_{Y}^{K}} \cdot G = MC \cdot G$$

Equation (7) directly yields the rule that the income equivalent benefit from public expenditures is inversely proportional to the marginal utility of income spent on private goods. If the elasticity of the marginal utility of income schedule is known, benefits may be allocated according to income class.[11] Empirical estimates of this magnitude will be discussed later.

2. Estimates of Demand Elasticities

A second major approach is to use estimates of the elasticities of demand as an indication of probable benefits from public goods supply to different income classes. A number of studies are available which derive price and income elasticities for municipal expenditures.[12] Neenan has explicitly recognized that the demand elasticity approach may be useful in estimating marginal evaluations for public services.[13]

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[11] Interestingly, Geoffrey Brennan, "The Distributional Implications of Public Goods", Econometrica, 1976, pp. 395-400, suggests that this magnitude may be unknowable. Aaron and McGuire, in "Reply to Geoffrey Brennan, 'The Distributional Implications of Public Goods'", Econometrica, 1976, pp. 401-04, agree with Brennan but claim this should not deter researchers from examining the problem. Maital (1973), op. cit., had asserted that the magnitude was estimable when the Brennan and Aaron and McGuire exchange was finally published.

[12] See the references cited in fn. 8.

[13] W. B. Neenan, Political Economy of Urban Areas, (Chicago: Markham Publishing Company, 1972), pp. 107-08. Neenan, in attempting to construct a "willingness to pay" multiplier, did not appear to recognize that a review of price elasticities of demand was as crucial as income elasticities.

However, the precise relationship between these studies and the Aaron and McGuire work has not yet been established.

Generally, these studies have estimated a demand equation of the form:

(8) $\log G_i = C + h \log Y + \varepsilon_i \log P_i$

where G_i = the quantity of the i'th public goods demanded
Y = income of the median voter
h = income elasticity of demand for the i'th good
P_i = tax-price of the median voter for the public good i
ε_i = price elasticity of demand for good i

More recent studies have included an explicit model of political determination. Based on the assumption that preferences are single-peaked (a monotonic increasing or decreasing function of income), the level of expenditure is determined by the median voter.[14] If the provision of public goods is efficient, and if price and income elasticities remain constant over the relevant range, these estimates are sufficient to permit benefits to be allocated identically to the Aaron and McGuire method.

As shown in equation (8) the demand equation is estimated in double log form. Researchers have not normally been concerned with discussing the utility function on which their estimating equation is based. However, Sato has shown that such demand equations are derived from an additive utility function of the constant elasticity of substitution (CES) form.[15] Thus, the specification of equation (8) rests on an underlying CES utility function which implies the independence assumed by Aaron and McGuire. Therefore, if both approaches are based on the same general form of the utility function, they should both yield identical benefit imputations.

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[14] Single-peaked preferences, and their implications, are developed in Duncan Black, The Theory of Committees and Elections, (Cambridge: Cambridge University Press, 1957).

To see how the estimated demand equations can be used to yield comparable benefit imputations, we begin with the Lindahl pricing rule. Under a Lindahl equilibrium, each taxpayer will be in equilibrium with his marginal rate of substitution equal to the tax price for a given quantity of public good. Using the Lindahl pricing rule to impute benefits to income classes, in the identical manner as Aaron and McGuire, the imputed benefits from public goods G are:

$$(9) \quad P_G^K \cdot G$$

where P_G^K = the tax price of individual K for the public good G.

In equilibrium, the sum of the tax-share must be equal to the total cost of providing the public good. Assuming constant costs:

$$(10) \quad \sum_K P_G^K \cdot G = MC_G \, G$$

If it is possible to find the tax structure which will ensure Lindahl equilibrium, then it is possible to impute benefits to each taxpayer. The change in P_G^K measures the change in per unit benefits as income changes.

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[15] K. Sato, "Additive Utility Functions with Double-Log Consumer Demand Functions", Journal of Political Economy, Vol. 80 (1972), pp. 102-24.

The analogue to the Aaron and McGuire benefit allocation rule is, thus: benefits from public goods are directly proportional to the elasticity of the tax-schedule which will ensure a Lindahl equilibrium.

This elasticity can be estimated from the price and income elasticities already available. It has been shown by Buchanan and by Bergstrom and Goodman that such a tax schedule can be derived from the price and income elasticities of demand for public goods.[16] The rule can be written:

(11) $\alpha = -h/\varepsilon_i$

where α = elasticity of the tax schedule which ensures Lindahl equilibrium.

For example, if the income and price elasticities of demand are both one, the implied elasticity of the tax structure is also one. This suggests benefits from public expenditures should be allocated in proportion to income.

Without explicitly using the implied elasticities of both price and income, Neenan constructed a "willingness to pay" index identical to α.[17] Assuming $\alpha = 1$ and calculating the percentage change in income, he was able to derive the implied percentage change in tax-price. However, this approach is weak. Rather than assuming a value for α, it is possible to derive it from the available empirical studies. A range of benefit distributions can then be computed for each value of α.

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[16] James M. Buchanan, "Fiscal Institutions and Efficiency in Collective Outlay", American Economic Review, Vol. 54, No. 2, 1964, pp. 227-35, and Public Finance in Democratic Process, (Chapel Hill: University of North Carolina Press, 1967); see also Theodore C. Bergstrom and Robert P. Goodman, "Private Demands for Public Goods", op. cit.

[17] William B. Neenan, Political Economy of Urban Areas, op. cit., p. 108, defines the willingness to pay index as $(\Delta P/P)/(\Delta Y/Y)$ and assumes it is equal to one.

It is important to note that α can also be interpreted as the elasticity of the marginal utility of income. The elasticity of the tax schedule, which will ensure a Lindahl equilibrium, is the percentage change in the slope of the linear budget constraint, for a given percentage change in income. In a Lindahl equilibrium:

(12) $MRS^K = P^K_G$

and the imputed benefits from public goods supply may be rewritten as:

(13) $MRS^K.G$

This result is identical to that of Aaron and McGuire. The close relationship between these two approaches is intuitively easy to follow. The Aaron and McGuire approach concentrates on the change in the marginal rate of substitution between public and private goods, while the elasticity approach concentrates on the change in the slope of the budget constraint which is equal to the marginal rate of substitution, both assuming quality is constant.[18]

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[18] In examining additive CES utility functions, Sato (1972), op. cit., notes the own-price elasticity of demand is equal to σh, where σ is the constant average elasticity of substitution. The relationship between σ and α may then be derived:

$$\alpha = -h/\varepsilon_i = \frac{h}{\sigma h} = -\frac{1}{\sigma}$$

Sato has also shown that the inverse of the average elasticity of substitution may be interpreted as the elasticity of the marginal utility of income. S. Maital (1973), op. cit., uses estimates of σ to derive estimates of the elasticity of the marginal utility of income. This enables him to use the Aaron and McGuire methodology to derive empirical estimates of the distribution of public good benefits across income classes.

3. Reasonable Assumption Approach

If the utility function previously discussed is accepted, a bridge to the "reasonable assumptions" approach can be constructed. Each reasonable allocation method implies certain assumptions about empirical magnitudes which can be checked against values obtained from empirical studies. In case of conflict, the particular "reasonable assumption" that is chosen will not yield a benefit imputation consistent with the Aaron and McGuire approach.

Consider first the equal benefit per capita (family) rule.[19] This implies that income equivalent benefits are the same for all individuals (families) in each income class. The same benefit allocation is implied by the Aaron and McGuire approach if the elasticity of the marginal utility of income is zero. Equivalently, the implied Lindahl equilibrium tax-price applicable to all income classes is identical if the income elasticity of demand for the public good is zero.

Second, consider the allocation of benefits in proportion to disposable income. If all tax revenues are used to provide public goods, then disposable income is a true measure of income available for expenditure on all other goods, and is used by Aaron and McGuire in their benefit allocation method. Since Aaron and McGuire consider only pure public goods, it is safe to conclude that disposable income is required, and, in fact, Maital interprets them in this way.[20] In this case, the

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[19] If the equal benefit per family rule is used, the utility function must be interpreted as applicable to the family unit.

[20] Shlomo Maital, "Public Goods and Income Distribution: Some Further Results", Econometrica, Vol. 41, No. 3, (1973), p. 561-68.

Aaron and McGuire approach suggests benefits be allocated in proportion to disposable income if the elasticity of the marginal utility of income is unitary. That is, if disposable income doubles and, as a result, the marginal utility of income falls by one-half, then benefits will also double with income. Alternatively, if the income elasticity has the same absolute magnitude as the price elasticity, then the elasticity of the tax structure which will ensure a Lindahl equilibrium is unitary. This also suggests benefits would be allocated in proportion to income.[21]

However, disposable income may not be the correct measure of income available for expenditure on all other goods. Governments provide a large number of services (other than direct transfers), the benefits from which are specific to particular groups. These benefits may be equivalent to income available for expenditure on all other goods. This would be true if the individual can substitute publicly supplied goods for private purchases, and if no substitution effect occurs. This has been assumed in the studies by Gillespie and Johnson and the same assumption is made here.[22] In this case, a broad income concept, which includes the income equivalent benefits from specific benefit goods, should be used. If this is not done, then individuals with the same disposable income but vastly different specific benefits would be erroneously allocated identical benefits from public goods.

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[21] For benefit imputation, it is crucially important to discover some information about the underlying utility function. For example, this result can be derived if the underlying utility function is Cobb-Douglas, a special case of the additive, CES utility function. The elasticities approach is one way of utilizing revealed information to infer something about individual tastes for public goods.

[22] W. Irwin Gillespie (1964, 1965, 1975), op. cit., and James A. Johnson, op. cit. This is implied when it is assumed that benefits received are equal to the cost incurred on behalf of a specific group. If a substitution effect could be identified, it would be desirable to reduce the implied income benefit.

In this third case, a reasonable assumption that public good benefits are proportional to broad income would imply the unitary elasticity of both the marginal utility of income and the tax schedule, which ensures a Lindahl equilibrium, as was discussed earlier. However, the disposable income magnitude will normally be an incorrect base if there are specific benefits which should be included in income.[23]

Finally, consider the assumption that benefits are proportional to capital income. This rule can be derived if the elasticity of the tax structure, which will ensure a Lindahl equilibrium, is identical to the elasticity of capital income with respect to a change in broad income. This also implies a specific value for the elasticity of the marginal utility of income -- that it be larger than one in absolute value. However, the elasticity of wealth with respect to income may not be monotonic, as will be discussed in the next chapter.

The empirical magnitudes of the elasticities under discussion determine whether any of the reasonable assumptions are appropriate. The empirical magnitudes may take a number of values and there is no reason to constrain the values to specific numbers. For this reason we feel it is desirable to use the methodology developed by Aaron and McGuire. In Table 4-1, we present a summary of the equivalences which exist among the alternative approaches.

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[23] If the elasticity of specific benefits with respect to disposable income is one, then allocating benefits according to disposable income would not bias the result.

An important critique of both the Aaron-McGuire and the demand elasticity approach is that debate over the empirical magnitudes of the parameters is not useful.[24] This critique questions the reasonableness of the independence assumption between private and public goods.

Proponents of the Aaron and McGuire approach have suggested that separability "does not seem unreasonable" or is "a reasonable compromise".[25] Thus, while the results of making reasonable assumptions are implied by specific values of the parameters, if the actual, underlying utility function is additive CES, the utility function may not take this form. As noted by both Sato and Maital, econometricians' revealed preference for this formulation is not sufficient to accept it without question. Sato suggests that there is evidence that the value of α may be roughly constant over wide income ranges and countries. The studies on which his argument is based all group related expenditures and assume separability between groups. There is strong reason to believe many quasi-private goods supplied by the government (e.g.,

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[24] This point has been made forcefully by Gillespie (1975), pp. 86-88.

[25] Henry Aaron and Martin C. McGuire, "Public Goods and Income Distribution", op. cit., p. 911; Shlomo Maital, "Public Goods and Income Distribution: Some Further Results", op. cit., p. 563, and "Apportionment of Public Goods Benefits to Individuals", op. cit., p. 408.

Table 4-1

Equivalences Among Alternative Approaches to Benefit Incidence

Distribution of Benefits	Allocation of Benefits by: Reasonable Assumptions	Demand Elasticities	Aaron McGuire
Pro-poor (benefit-income ratio declines with higher incomes)	families	$\frac{h}{\varepsilon} = o$ (or $h = 0$)	$\alpha = 0$
Neutral (constant benefit-income ratio)	disposable income	$\frac{h}{\varepsilon} = 1$	$\alpha = 1$
Pro-rich (benefit-income ratio rises with higher incomes)	wealth	$h/\varepsilon = \phi$	$\alpha = \phi$

NOTE: As before, h denotes the income elasticity of demand, ε the price elasticity, and α the elasticity of the marginal utility of income. The symbol ϕ is introduced to denote the elasticity of wealth with respect to income, assumed to be larger than unity.

transportation) are in fact not independent of private goods consumption. Nonetheless, the Aaron and McGuire methodology has been developed for public goods, and if these are considered as a group, separability may not be unreasonable.

If the relationship is one of substitutability, then an increase in private good income will lower the marginal utility of the public good. If the relationship is one of complementarity, the converse holds. In the case of substitutability, the implied benefits from public goods declines, and using the value of $-1/\sigma$ will tend to overstate the benefits received as income rises, while the converse is true for complementarity.[26] More empirical research is needed in this area to determine the appropriate adjustments to the parameters.

Recognizing the problem, Gillespie suggests there is no strong case for assuming independence. For specific expenditures, this argument is compelling. However, this methodology has been developed to allocate benefits from public goods. It appears that the "reasonable assumptions" approach should now be abandoned in favor of the Aaron and McGuire general framework. The theoretical foundation of the Aaron and McGuire approach is strong. If the disagreement is with the degree of interdependence with specific government expenditures, then the appropriate interim course is to make reasonable corrections in the parameters. The long-run course suggested is to attempt to estimate empirically the nature of these interdependencies.[27]

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[26] To see this point, remember that $MRS = MU_G/MU_Y$. Then if MU_G is constant, MRS will rise as MU_Y declines. That is, the implied tax-price rises as income rises. However, if private goods are substitutes for public goods, then, as income rises, MU_G will fall. That means $MU_G/MU_Y = MRS$ will not rise at the same rate as when MU_G was constant. That is, substitutability implies that the tax-price rises at a lower rate as income increases. This point has been stated incorrectly by K. V. Greene, W. B. Neenan and C. D. Scott, Fiscal Interactions in a Metropolitan Area, op. cit., p. 46, and S. Maital, "Apportionment of Public Goods Benefits to Individuals", op. cit., p. 408.

C. Estimates of Empirical Magnitudes

Both Sato and Maital provide a number of empirical estimates of the value of the elasticity of the marginal utility of income. All have yielded estimates in excess of one, implying that benefits are more than proportional to income. For Canada, Powell has estimated $\alpha = 1.55$, although he thought this estimate too low and suggested 2.0 might be a better one.[28] Maital adopts the 1.55 estimate in computing the benefits from public expenditures in Canada. Greene, Neenan and Scott used a value of 1.5 for the United States, but thought an ad hoc adjustment for complementarity was warranted. This reduced their estimate to 1.0. However, such a reduction is warranted only if the relationship is one of substitutability, an error which perhaps points up the problems in making ad hoc adjustments in the absence of more complete information. They also feel that voter attitude and survey data support a value of 1.0. Our review of Neenan's work does not suggest that this strong support is warranted.

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[27] Geoffrey Brennan, "The Distributional Implications of Public Goods", Econometrica, Vol. 44 (1976), pp. 395-400, has argued that Lindahl pricing is an inappropriate analogue to uniform pricing in the private sector. Brennan argues, persuasively, that the appropriate analogue is equal benefits per capita. Aaron and McGuire, the "Reply to Geoffrey Brennan, 'The Distributional Implications of Public Goods'", Econometrica, Vol. 44, pp. 401-04, respond that public goods are different by nature and, second, that their system yields a good ordinal measure of the direction of welfare change if a change is made in the public sector. This is not the place to enter this debate. It is sufficient to say that Aaron and McGuire's methodology does have a solid theoretical foundation. Furthermore, as Brennan notes, the Aaron and McGuire methodology is bias-free if the change in benefits, resulting from a change in the public sector is considered.

[28] A. Powell, "Post-war Consumption in Canada: A First Look at the Aggregates", Canadian Journal of Economics and Political Science, 1965.

Additional evidence may be obtained from estimates of price and income elasticities for public goods. Several studies have recently yielded such estimates for local public goods. In reviewing these studies, Borcherding concludes that the price elasticity is around -.5.[29] The income elasticity may range from .75 to 1.5. Borcherding suggests that the lower range may be the best estimate, but that is not yet clear. These figures suggest that the tax structure which will ensure a Lindahl equilibrium has an elasticity in the range of 1.50 to 3.0. The lower range suggested by Borcherding supports the value of 1.55 used by Maital. In the absence of more complete information, there is little reason to adjust these estimates for interdependence between public and private goods.

These econometric estimates also receive some support in Shoup's enlightening discussion of the distribution of the benefits from local government services.[30] Although he provides no quantitative estimates of these distributive effects, he offers substantial insight into how benefits are probably arrayed across income classes. Fire protection and crime prevention (police forces) both serve to avoid damages to property and personal injury or fatality. If local officials allocated a given amount of these services so as to equalize the crime or fire rate in rich and poor districts, their distributive effect might be more or less neutral with respect to income, since the same loss in a rich area would be worth more than if it occurred in a poorer neighborhood. In fact, however, it seems that service-level disparities typically work against the poor who commonly reside in districts with above-average crime and fire rates. This may reflect the conscious or unconscious desire of local officials to allocate these services so that the *value* of actual losses is approximately the same everywhere. Thus, the value of crimes and fires prevented may be greater in richer areas.

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[29] See the references cited in fn. 8. Also, see Thomas E. Borcherding, "The Sources of Growth of Public Expenditures in the United States, 1902-1970", Simon Fraser University Discussion Paper 74-8-2.

[30] Carl S. Shoup, Public Finance, (Chicago: Aldine Press, 1969), Chapter 5. Shoup's assessment is supported by Richard M. Bird's study, Charging for Public Services: A New Look at an Old Idea, (Toronto: Canadian Tax Foundation, 1976), Chapter 4.

With regard to both street services, and cultural and recreational services, it is not unusual for richer areas to be blessed with better service. New parks, for example, are often located in suburbs out of easy travel range for the residents of poor neighborhoods. However, the largest item in local budgets is education which accounts for about one-half of all spending. Distribution of this item has not been nearly settled by econometric technique since existing estimates of demand parameters diverge rather widely.[31] If called upon to take a stand, we would agree with Shoup's assessment, that more education is distributed to high- than to low-income households but by not enough to make the resulting distribution of benefits proportional to income.[32] Moreover, in most rich school districts the consumption of more educational services is ordinarily matched by higher school taxes.

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[31] Barlow, op. cit., relies on a double-log formulation to generate values for the income and price elasticity of educational demand of .64 and -.34 respectively. Feldstein, on the other hand, obtains values of .7 for income and a range of 0.94 to -1.64 for price for the same elasticity parameters. See M. Feldstein, "Wealth Neutrality and Local Choice in Public Education", *American Economic Review*, March 1975. Taking both studies together, the elasticity of the possible Lindahl tax schedule may vary between about .5 and 1.9.

Our own subjective weighting of these different components in the structure of local government budgets suggests that the appropriate Lindahl tax schedule for a proportional expansion of local spending would have an elasticity somewhere in the range of unity (benefits proportional to income) to 1.5 (benefits rising as a fraction of income). This uncertainty (by no means unique to us) represents what we feel is, perhaps, the major weakness in our study and one which makes it a prime target for future research, in view of the growing, relative importance of the local, public sector.

D. The Likelihood of Benefit Shifting

We have seen in earlier chapters that people or income groups that pay the taxes need not be those who carry the burden of the tax. Similarly, those who initially receive the benefits of public expenditure may not be those who ultimately enjoy this bounty. In the case of partial product or factor taxes, nominal taxpayers are able either to share or escape their burden, depending on their degree of factor mobility (ability to move to nontaxed employments) and willingness to purchase nontaxed goods. Shifting occurred when taxed groups could respond to the opportunity of nontaxed alternatives.

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[32] That the rich stand to benefit handsomely from the consumption of education by the poor in a modern welfare state, primarily from the generation of fiscal externalities (reduced welfare support, etc.) but also as a result of "real" externalities (reduced crime, for example), is the theme of a book by J. Owen, School Inequality and the Welfare State, (Baltimore: Johns Hopkins Press, 1974).

Benefits from publicly supplied services operate in a similar fashion, except that the critical distinction in this case is between geographic areas, or fiscal jurisdiction, that offer different benefit levels. Most public goods have a spatial dimension which permits geographic discrimination in the provision of benefits. National defense is one of the few exceptions to this rule of area specific benefits. Assume that benefits from higher public spending in a single, fiscal unit accrue only to residents of that area. Users of public services will be the initial beneficiaries and can be identified in the manner described above. Assuming that the taxes required to pay for these services are not strongly benefit-related, this particular jurisdiction will appear as a more favorable location to outsiders. If outsiders migrate to this area, they will reduce their demand for land in their present locations and bid up the price of land in their new location. Relative land values will adjust until migrants can no longer achieve a higher level of utility by changing their place of residence. Initial residents, however, will face a higher charge for their choice of location, with the result that much of the value of higher, public-goods benefits will be capitalized into land values. Landowners, in our fiscal unit, will be the ultimate beneficiaries from the higher level of benefits provided. Of course, these higher land values will occur at the expense of lower land values outside the area.

This process of benefit shifting will not occur unless two requirements are met. First, there must be a significant degree of individual mobility in response to locational variation in benefits levels. Secondly, the fiscal change must be partial and, thereby, affect the relative attractiveness of residence in different areas. If the same relative improvement in benefits occurred everywhere, no one would have any incentive to change his location. Only differential changes can influence the spatial distribution of society and the pattern of land rents. In other words, there is a fiscal symmetry to the tax side here, since only benefit differentials will tend to be capitalized in land values.[33] Two implications of this view follow directly. One is that the value of the absolute level of any public amenity will never be accurately reflected in land values. The other is that benefits from national public goods, such as defense, will never be subject to shifting.

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[33] A formal model of this process with varying degree of mobility is developed by A. Mitchell Polinsky and Steven Shavell, "Amenities and Property Values in a Model of an Urban Area", The Journal of Public Economics, Vol. 5, 1976.

Note that in our model we also expect tax differentials to be capitalized into land values. Thus, the burden of a tax increase, for example, will be borne, both now and in the future, by current landowners. The problem of determining who bears a given tax is much more difficult to resolve since it is almost impossible to identify original owners.

As a related point, the after-tax capitalization rate at which future, after-tax rentals are valued is an endogenous variable in our general equilibrium model. Frequently both the rate and the rentals move in the same direction so that any induced, wealth effects may not be as strong as one might suspect.

PART III: An Application to Transfer Payments

A. Introduction

Transfer payments will be considered in two conceptually distinct components. First, the transfer is made from a donor or group of donors. Second, the transfer is received and treated as an increment-to-income by welfare recipients. The issue to be considered is the amount of benefits to be allocated to each income class as a result of this activity. The traditional approach has been to ignore the use-of-income benefits accruing to donors and to concentrate on the benefits received by recipients. This approach is rejected as partial and misleading, and income equivalent benefits to both groups will be considered.

B. Benefits to Recipients

It has been recognized in benefit incidence studies that recipients are made better off as a result of welfare payments. Welfare transfers induce an income effect in recipients equal to the amount of the transfer. Furthermore, these studies assume that transfer payments are not shifted so that an adjustment need be made in the amount of benefits effectively received by recipients.[34] Greene, Neenan and Scott have recently argued that "the value of the possibly increased leisure time" should be included.[35] They also recognize the practical difficulties that this proposal raises, and concede that this component need not be included. In this study, welfare payments will be allocated as benefits to recipient income classes.

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[34] "We assume that the benefits of these transfer payments are not shifted from the initial recipients. Thus, contrary to most expenditure programs, the impact of these expenditures on the income of families is both direct and exact." Johnson (1967), p. 58.

"... it is assumed that direct transfer payments, like the personal income tax, cannot be shifted from those families who receive such social welfare transfers." Gillespie (1965), p. 122.

If benefit incidence studies were bound to use a national income concept of income, the discussion could end at this point. All transfer income has been allocated to recipients. Fortunately, this constraint does not apply. As writers on income measurement have long recognized, a transfer may be considered a use of income to the donor and a source of income to the recipient. Hence, there has been no hesitation in recommending full taxation of gifts received out of after-tax income. Similarly, it may be that donors also benefit from transfers and if so, the transfer is a use of income which improves the welfare of the donor. It is both possible and likely that the public finance concept of income will exceed the national income magnitude.

C. Donor Benefits

If donors are made better off as a result of transfers, then benefits can be imputed to them. Advances in the application of Paretian welfare economics to redistribution have made it possible to undertake a more rigorous analysis than is found in most earlier benefit incidence studies. Prior to the seminal work in this area, redistribution was considered to be forced through the political process.[36] Individual preferences were (normally) followed in the provision of public goods but redistribution did not fall into that category. Within such an authoritarian framework, imputing no benefits to donors was correct. Buchanan criticised this dichotomous treatment of distribution and allocation in a review of Musgrave's The Theory of Public Finance, a treatise which established the most prevalent framework for analysing the public sector.[37] A decade later, in response to a rigorous demonstration that transfers may also be required for efficiency, Musgrave offered to divide the Distribution Branch into two parts, one concerned with voluntary, the other with involuntary, redistribution.[38] The implications of this division must be considered.

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[35] Kenneth Greene, William G. Neenan and Claudia D. Scott, Fiscal Interactions in a Metropolitan Area, op. cit., p. 32.

If redistribution is entirely involuntary, then no benefits can be imputed to donors. However, it is not true that all redistribution is forced. Considerable intellectual effort has been expended to show that there are numerous reasons for voluntary transfers through the political process.[39] The first discussions were in terms of a genuinely altruistic motivation by the rich. In this case, where the utility level of the rich is affected by the income of the poor, the rich are hypothesized to be made better off if the income of the poor increases. In the two-person case, where there is one rich and one poor person, the rich person will voluntarily transfer income if the $MRS_{Y^PY^R}$ is greater than one (Y^P = income of poor person; Y^R = income of rich person). The voluntary transfers will continue until $MRS_{Y^PY^R}$ equals unity.

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[36] E. O. Olsen, "A Normative Theory of Transfers", Public Choice, Vol. 6, Spring 1969, and Harold M. Hochman and James D. Rodgers, "Pareto Optimal Redistribution", American Economic Review, Vol. 59, No. 4, Part I, (1969).

[37] James M. Buchanan, "The Theory of Public Finance", Southern Economic Journal, Vol. 26, No. 3, (1960) and Richard A. Musgrave, The Theory of Public Finance, (New York: McGraw-Hill, 1959).

[38] This was in a comment on the Hochman and Rodgers article, Richard A. Musgrave, "Pareto Optimal Redistribution--Comment", American Economic Review, Vol. 60, No. 5, (1970).

While altruism is the most pleasant reason for transfers, it is certainly not the only justification. It has been argued that donors may not wish to see the visible signs of poverty, although this argues for transfers which cover up rather than eliminate poverty.[40] Additionally, property owners may redistribute to reduce the possibility of social unrest and, hence, maximize the expected value of their property. Other people may redistribute for the purpose of appearing charitable.[41]

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[39] In the blossoming literature on Pareto-desirable transfers, see also, Robert H. Scott, "Avarice, Altruism and Second Party Preferences", The Quarterly Journal of Economics, Vol. 86, No. 1, (1972) and Lawrence D. Schall, "Interdependent Utilities and Pareto Optimality", The Quarterly Journal of Economics, Vol. 86, No. 1 (1972).

[40] James M. Buchanan, "What Kind of Redistribution Do We Want?", Economica, Vol. 35, Nos. 137-40, (1968), pp. 185-190.

[41] See James M. Dean, "Redistribution and Tax Concessions for Charitable Contributions", Public Finance, Vol. 28, No. 3-4, 1973.

In fact, it has even been argued that avarice and greed are sufficient motivation to justify Pareto-desirable redistribution.[42] Whatever the motivation, it is likely that there is a greater desire to help the poor who are spatially close rather than farther away. This does appear to be true for municipal welfare programs, for which public pronouncements often talk of the need to help the poor in our midst.[43]

While transfers may be justified as Pareto-desirable, they still may not be made by individuals acting alone. When there is a large number of potential donors, and all donations are perfect substitutes, the efficiency condition for transfers becomes $\Sigma \mathrm{MRS}_{Y}\mathrm{P}_{Y}\mathrm{R} = 1$. In this large number case, the market may fail: first, because there is no incentive for an individual to organize collective action and, second, because even if collective action is taken, there is no means of ensuring that some potential donors do not drop out and "free-ride" on the remaining donors.

In this case, collective action may be undertaken by the government. A political entrepreneur can be expected to propose collective action on transfers, and to be elected if the post-transfer position is a Pareto improvement for the median voter. Second, since the government has a compulsory tax payment mechanism, it is not possible for some persons to drop out and improve their position through failure to pay for benefits received. The problem which arises for the empiricist, is that it becomes increasingly difficult to know if the redistribution is forced or voluntary.

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[42] Geoffrey Brennan, "Pareto Desirable Redistribution: The Case of Malice and Envy", The Journal of Public Economics, Vol. 2 (1973), pp. 173-83.

[43] This has been advanced by M. V. Pauly, "Income Redistribution as a Local Public Good", The Journal of Public Economics, Vol. 2 (1973). The spatial dimension of public goods has been discussed by James M. Buchanan, The Demand and Supply of Public Goods, New York: Rand-McNally, 1968.

In benefit incidence studies, other public goods are assumed to be supplied in response to individual preferences.[44] This may also apply to welfare transfers. There is a substantial amount of redistribution undertaken by individuals with no government involvement. There is also a strong theoretical argument in favor of public provision of redistribution to satisfy the preferences of donors. Since redistribution is a public good, there is little reason to assume the government does not supply it efficiently.[45]

Furthermore, at the municipal level, welfare programs are almost entirely composed of direct, supplemental assistance to the needy, where the redistribution to the poor is more direct and certain than is the case with more general welfare programs, such as family allowances and unemployment insurance. Utilizing the median voter analysis developed by Black, it is possible to hypothesize that the level of welfare expenditures is determined by the median voter.[46] With substantially more residents being potential donors, it is difficult to hold that the median voter would vote for such payments unless they improved the voter's welfare.

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[44] Examinations of the role of the political process in ensuring that individual preferences are satisfied is a relatively new area. See Anthony Downs, An Economic Theory of Democracy, (New York: Harper and Row, 1957); James M. Buchanan and Gordon Tullock, The Calculus of Consent: Logical Foundation of Constitutional Democracy. (Ann Arbor: University of Michigan Press, 1962) and M. Olsen, The Logic of Collective Action, (New York: Schocken Books, 1965).

[45] Contrary to James M. Buchanan and Gordon Tullock, The Calculus of Consent: Logical Foundations of Constitutional Democracy, it is equally likely that the public sector is underexpanded.

[46] Duncan Black, The Theory of Committees and Elections. (Cambridge: Cambridge University Press, 1957). This analysis is now common in public goods research.

For these reasons, it is thought that municipal welfare transfers can be considered to be voluntary. Utilizing the Pauly discussion, it is also held that the beneficiaries are those potential donors in close proximity to the welfare recipients.[47]

How are the benefits distributed among donors? Earlier, it was noted that the efficiency condition for donors was $\Sigma MRS_{Y\ Y} = 1$. Greene, Neenan and Scott interpreted this condition to imply that all individuals above the $5,000 income level were potential donors and should be allocated use-of-income benefits.[48] They considered the income elasticity of marginal utility to be unity, and used this value in the Aaron and McGuire framework to allocate income-equivalent benefits to income classes.

Our review of the empirical literature suggests that a value of unity may not be unreasonable. Guidance in this matter is available from estimates of the price and income elasticities of private charity. While recognizing that public and private charity might be very different goods, we do feel that information on private charity may yield useful information on public charity. Substantial amounts of research have been done in the area of private charity, primarily utilizing data on personal income tax deductions for charitable contributions. Schwartz found the price elasticity for individuals in the \$10,000 to \$100,000 income bracket to be -.79, while the income elasticity for the same group was .76.[49] This suggests a value for the elasticity of the Lindahl tax-schedule of approximately one. Feldstein, in a substantial study of charitable contributions, found the aggregate income elasticity to be .822 and the price elasticity to be -1.238, suggesting a value for α of -.66, somewhat lower than the value of one implied by Schwartz.[50] Other studies, such as those of Zimmerman, and Hochman and Rodgers, estimate income elasticities which range around these values but do not include price elasticities.[51] We suggest that a tentative value of unity be given to the elasticity of the Lindahl tax schedule. This particular value reflects the fact that public and private charity are substitutes, and, according to our earlier discussion, is appropriately smaller than the value of 1.5 used in other studies. They are not perfect substitutes, however, and it is most unlikely that an extra dollar of public transfers would replace a dollar of private, charitable donation.

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[47] M. V. Pauly, "Income Redistribution as a Local Public Good", op. cit.

[48] Kenneth V. Greene, William G. Neenan and Claudia D. Scott, op cit., p. 48.

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[49] Robert A. Schwartz, "Personal Philanthropic Contributions", Journal of Political Economy, Vol. 78, No. 5 (1970), pp. 1264-91.

[50] Martin Feldstein, "The Income Tax and Charitable Contributions: Part I--Aggregate and Distributional Effects", National Tax Journal, Vol. 28 (1975), No. 1, pp. 81-100, and "The Income Tax and Charitable Contributions: Part II--The Impact on Religious, Educational and Other Organizations", National Tax Journal, Vol. 28, No. 2 (1975), pp. 209-26.

[51] Dennis Zimmerman, "On the Relationship Between Public Goods Theory and Expenditure Determinant Studies", National Tax Journal, Vol. 28, No. 2, (1975), pp. 227-39; Harold M. Hochman and James D. Rodgers, "Utility Interdependence and Income Transfers Through Charity", in K. E. Boulding, Martin Pfaff and Anita Pfaff (editors) Transfers in an Urbanized Economy (Belmont: Wadsworth Publishing Company, 1973). Again, it must be noted that these estimates are for private charity and not publicly transferred welfare payments. Still, we feel the magnitudes are likely to be comparable in either case.

In summary, we will allocate total welfare payments as donor benefits accruing to all income classes which do not receive municipal welfare. These donor benefits are considered to be a pure public good and benefits will be imputed to each income class by using the Aaron and McGuire methodology. Thus, the total donor benefits accruing to all income classes will equal the total amount of welfare payments.

In addition to benefiting donors, the transfers benefit those individuals who are recipients of aid. The welfare payments are a pure private good to recipients. Accordingly, the total welfare payments will be allocated to income classes which receive transfers according to the amount of welfare payments actually received by each income class. To reiterate, the total benefits allocated to all income classes, both donor and recipient, will be twice the total amount of welfare payments actually made.

PART IV: An Application to Public Transit

A. Direct Benefits

In this section, the methodology of benefit incidence will be applied to public transit. Specifically, we will discuss the allocation of benefits from expenditures on public transit. This will involve considering both the direct and indirect effects on income distribution, although in this sub-section only the direct effect will be discussed.

From the standpoint of municipal expenditures, what is of interest is the allocation of benefits from the deficit incurred by public transit.[52] If public transit is subsidized, the user is paying less than the average cost of production. This reduced price may be viewed as a negative sales tax on public transit. The implied benefit incidence is then found by allocating the subsidy among income classes in proportion to their frequency of usage of public transit.[53] Since the services of public transit are marketed, these benefits show up on the uses-of-income side of incidence as discussed earlier.

Frankena has utilized this approach to allocate the benefits of public transit subsidies in Canada.[54] He notes that the largest subsidies are paid on suburban routes, where the average income of users is higher than in the municipality as a whole. Second, he notes that many special, public transit programs, involving substantial subsidies, are aimed at attracting suburbanites to the public transit system.[55]

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[52] Note that the deficit may not be uniform on all transit routes. Most cities do not have a zone fare structure and so the deficit is larger on long distance routes. This may involve cross-subsidization from transit users who live close to the centre of the city to transit users who live in the suburbs.

[53] See for example, Gillespie (1975). Gillespie does not look at public transit specifically. Instead, it is presumably lumped under "Other Transportation Expenditures", the benefits from which are allocated equally to consumers of otner transportation services and consumers of transported products.

[54] Mark Frankena, "Income Distributional Effects of Urban Transit Subsidies", Journal of Transport Economics and Policy, Vol. 7, No. 3, (September 1973), pp. 215-30.

[55] For example, Dial-a-Bus programs are heavily subsidized and available only in the suburbs.

This, again, involves substantially higher benefits for above-average, income classes. In this study, however, general changes in public transit subsidies will be considered to apply to all transit users rather than to those in specific areas of a municipality.

B. External Effects Induced by Public Transit

Increasing subsidies to public transit induce changes in automobile usage which provide external benefits. Allocating these benefits to income classes enables us to supply a more accurate indication of the income-distribution effects of public transit subsidies than would be possible if they were excluded. These external effects take several forms. First, a reduction in the number of automobiles using urban roads reduces the congestion on these roads.[56] Reduced congestion enables remaining automobile users to average a higher speed than previously, saving them time spent travelling. This time-saving can then be valued at the opportunity cost of travel time for each income class.

The second group of external effects are the reduction in air (and noise) pollution which occur with fewer vehicles travelling on urban roads. These benefits accrue to all urban residents. Finally, there are reduced investments in roads and associated facilities such as parking garages. In this section, no attempt will be made to estimate or allocate the benefits from the last two sources.[57] However, an attempt will be made to allocate the benefits arising from reduced travel time as congestion is lowered.

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[56] For a discussion of the improvement in congestion, see Roger Sherman, "Congestion Interdependence and Urban Transit Fares", Econometrica, Vol. 39, No. 3, (1971), pp. 565-76; and "Subsidies to Relieve Urban Traffic Congestion", Journal of Transport Economics and Policy, Vol. 6, No. 1, (1972), pp. 22-31.

From existing empirical studies, estimates are available of the cross-elasticity of demand for automobile use, elicited by a change in the price of public transit.[58] These estimates range in size from approximately .08 to approximately .2. One study estimates .14 as the elasticity of auto trips for a given change in transit price.[59] In this study we assume the elasticity of auto trips for a given change in transit price is .2.[60] Choosing this higher value may partly offset the excluded benefits discussed above.

For a given reduction in automobile travel, it is also necessary to know the quantity of time saved by the remaining auto users.

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[57] One study which attempts to estimate these benefits is N. Sheldon, The Economic and Social Impact of Investments in Public Transit, (Lexington, Mass.: Lexington Books, 1973)

[58] For a review of transit elasticities, see Michael A. Kemp, "Some Evidence of Transit Demand Elasticities", Transportation, Vol. 2 No. 1, (1973), pp. 25-52, and the references therein.

[59] One point should be noted. The cross-elasticities mentioned are true indicators of the decrease in traffic only if there is currently sufficient excess capacity on buses to absorb the additional passengers. If additional buses are used to carry these passengers, then the true decrease in traffic is the difference between the reduction in the number of automobiles and the increase in the number of buses, weighting each bus at a three-car equivalent.

[60] There is considerable evidence that the elasticity of automobile demand for a change in transit service (such as transit waiting time) is considerably higher than the corresponding figure for transit price. Kemp, op. cit., cites a figure of .37, more than twice the cross-price, elasticity estimate of .14 from the same study. This points out the importance of considering alternative experiments in which increased transit subsidies are used to finance improved service as well as to reduce fares.

Estimating this magnitude requires a knowledge of the engineering relationship between average speed and the number of cars on the road. In this area we are not experts, but some estimates are available. Walters suggests that for British urban travel, the engineering relationship between average speed in miles per hour (v) and the number of vehicles per hour (q) is given by:[61] $v = 25 - .014q$

Assuming this relationship can be meaningfully applied to Canada, it is possible to estimate the elasticity of average speed for a change in the number of automobiles (ηvq). From the above equation, this is computed to be $\left(\frac{25-v}{v}\right)$. Using this relationship, ηvq can be estimated for several different average speeds.

Walters defines severe congestion as average speeds less than 10 m.p.h., moderate congestion as speeds of 10 to 14 m.p.h., and mild congestion as average speeds of 15 to 20 m.p.h. While average speeds of 6 to 8 m.p.h. are common in central business districts in large cities, the average speed for the entire trip of an average automobile is higher.[62] Assuming several values for average speed, ηvq is estimated as:

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[61] A. A. Walters, The Economics of Road User Charges, (Washington: World Bank Staff Occasional Paper Number Five, IBRD, 1968), p. 174.

[62] Thomas A. Domencich and Daniel McFadden, Urban Travel Demand: A Behavioral Analysis, (New York: American Elsevier, 1975). See also Robert E. Paaswell, "Problems of the Carless in the United Kingdom and the United States", Transportation, Vol. 2, No. 4 (1973), pp. 351-72, for a note that average peak-hour, transit speeds are 2-6 m.p.h., the higher range being reached when reserved lanes were available.

Table 4-2

Congestion-Average Speed Relationships

Average Speed (m.p.h.)	Elasticity of Average Speed with Respect to Congestion (ηvq)
10	1.5
15	.67
20	.25

As can be seen from Table 4-2, the "worse" is initial congestion, the "greater" is the percentage improvement in average speed for a given reduction in automobile usage.

To estimate total time-saving, it is also necessary to include an estimate of the average distance to work (d). Since the municipal sector is composed of both large and small centres with widely divergent average distances to work, several estimates are used. The average distance to work (d) will be assumed to be 8, 10, and 15 miles in our estimates.

It is now possible to estimate the average time saved per trip for each person still using an automobile. We have discussed the responsiveness of automobile usage to a change in the price of public transit. For a one percent decrease in tho price of public transit, automobile usage declines by .2 per cent. This induced reduction in automobile usage reduces congestion and increases average speed for the remaining automobiles. For a one per cent decrease in the price of public transit, average speed will increase by .2 (ηvq) per cent.[63]

By making several alternative assumptions about the average distance to work, it is possible to compute the time-saving which accrues to automobile users on each trip. Finally, it is possible to convert these estimates into total time-savings per year. This can be done by estimating the number of one-way automobile trips made, on average, during the year. Assuming the number of one-way automobile trips per year is 600 (or 300 two-way trips), the total time-saving per year is estimated. The results are summarized in Table 4-3.

Having computed total time saved, it is possible to value this time at a monetary equivalent, to measure the change in income for each income class.[64] A number of studies have been completed which attempt to estimate the shadow price of travel time. Cesario, in reviewing a number of these studies, points out that there is surprising unanimity that the opportunity cost of time spent in travel is between one-quarter

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[63] For example, if ηvq equals 1.5, then average speed will increase by 1.5 per cent for each one per cent decline in automobile usage. However, a one per cent decline in the price of public transit induces only a .2 per cent decline in automobile usage. So, if $\eta vq = 1.5$, a one per cent decline in the price of public transit will increase average speed by .3 per cent.

[64] For an excellent study of the role of time in transport studies, and data on total time travelling by income class, see P. B. Goodwin, "Generalised Time and the Problem of Equity in Transport Studies", Transportation, Vol. 3, No. 1, (1974), pp. 1-23.

Table 4-3

Average Time Savings Per Year for Alternative Assumptions About Congestion and Average Distance to Work (in Hours)

ηvq \ d	8	10	15
1.5	1.44	1.8	2.7
.67	.42	.52	.78
.25	.12	.15	.225

Note: These estimates are for each one per cent decline in the price of public transit.

Method: Each value of ηvq implies a specific average speed as given in Table 4-2. By dividing average distance by average speed, the initial time involved in each one-way trip can be estimated in hours. Now, the increase in average speed for a one per cent decline in the price of public transit is .2 (ηvq) per cent. Multiplying the percentage increase in average speed by the initial time per trip yields an estimate of the time saved per trip for a one per cent decline in the price of public transit. Multiplying this result by the 600 one-way trips assumed each year, yields an estimate of the average time saved per year, in hours, for a one per cent decline in the price of public transit.

and one-half the wage rate.[65] Furthermore, there is evidence to suggest that this fraction is approximately constant over income classes. Cesario suggests using one-third of the wage rate on the grounds that the lower estimates are normally associated with British data, while higher estimates are obtained from U.S. studies. In fact, Guttman has suggested that most of these studies are too simple and that peak-hour travel time is valued at approximately 50 per cent more than other travel time.[66] Given this uncertainty, it is thought that a shadow price of one-third the wage rate is reasonable. The hourly wage rate is computed from information on annual income, assuming that the income earner works 2,000 hours per year.

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[65] Frank J. Cesario, "Value of Time in Recreation Benefit Studies", Land Economics, Vol. 52, No. 1, (1976), pp. 32-41. See also, C. J. Oort, "The Evaluation of Travelling Time", Journal of Transport Economics and Policy, Vol. 3, No. 3, (1969) pp. 279-86; and D. A. Quarmby, "Choice of Travel Mode for the Journey to Work", Journal of Transport Economics and Policy, Vol. 1, No. 3, (1967), pp. 273-314.

Thomas A. Domencich and Daniel McFadden, Urban Travel Demand: A Behavioral Analysis, op. cit., derive the traditional results that the value of time spent in a vehicle has a markedly lower value than time spent walking. This aspect of the problem is not considered here. Ideally, the reduced time spent looking for a parking spot should also be included.

[66] Joel Guttman, "Avoiding Specification Errors in Estimating the Value of Time", Transportation, Vol. 4, No. 1, (1975), pp. 19-42. Another recent study which finds the value of time may be two-thirds the wage rate in recreation travel only is Peter L. Watson, The Value of Time: Behavioral Models of Modal Choice (Lexington: D. C. Heath, 1974). Watson notes the commuting value of time is much lower, but he reaches this conclusion by comparing his results with commuting time estimates prepared elsewhere.

Using this methodology, we have estimated the value of reduced congestion to different income classes. In Table 4-3 we have estimated the time savings from a one per cent reduction in the price of public transit. The value of reduced congestion is worth more the greater the time-saving. For example, we estimate that a \$1.00 increase in the subsidy to public transit will induce total external benefits which range from a low of \$.21 to a high of \$4.67. Where $\eta vq = .67$ and $d = 10$, the external benefits are \$.90 for each \$1.00 increase in the subsidy to public transit.[67]

Of course, not only the value of the external benefits, but also the distribution of these benefits across income classes, is important. Estimates of the benefit distribution by income class are given in Table 4-4. Note that 32.2 per cent of the external benefits accrue to the highest income class. This is due to two factors. First, the

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[67] The conversion from elasticities to absolute magnitudes has relied on the following calculations. According to the Expenditure Survey, one per cent of total spending on urban transit (item 820) by all income classes is about \$1.8 mn. We assume that this amount represents the value of a one per cent reduction in the price of urban transit. For all income classes, it is estimated that an hour of time saved would be worth about \$3.1 mn., using the shadow price of one-third of the wage rate. Thus the ratio of \$3.1 mn. to 1.8 mn. generates the result that about \$1.73 of external benefits per dollar of fare subsidy occur for each hour of time-saving. How much time will actually be saved by a one per cent fare reduction depends on initial congestion and average driving distances, as shown in Table 4-3. For median values of $d = 10$ miles, $\eta vq = .67$ it is seen that about .52 hours would be saved. In this case the value of the external benefit is about one-half of \$1.73, or \$.90 to be exact, per dollar of transit subsidy.

Table 4-4

The Distribution of Transit Expenditures and External Benefits, by Income Class

Income Class ($)	Per cent Public Transit Expenditures	Per cent External Benefits
under 3,000	11.5	.4
3,000 - 3,999	7.5	.7
4,000 - 4,999	7.0	1.7
5,000 - 5,999	8.4	3.0
6,000 - 6,999	6.9	5.0
7,000 - 7,999	8.3	6.5
8,000 - 8,999	8.3	7.6
9,000 - 9,999	6.3	8.6
10,000 - 10,999	10.9	7.8
11,000 - 11,999		7.3
12,000 - 14,999	12.9	19.1
15,000 and over	12.4	32.2

Source: Computed from *Family Expenditure in Canada, Vol. 1, All Canada, Urban and Rural*, (Statistics Canada, 1969). No. 62-535.

Methodology: Col 2. The per cent of public transit expenditures by income class is computed directly. Col. 3. The value of external benefits for each income class, when there is a one per cent decline in the price of public expenditures, is found by multiplying the shadow price of time by the total time savings estimated in Table 4-3. This result is multiplied by the number of families in that income class. Finally, this result is multiplied by the per cent of families in that income class who own automobiles. Having computed the total external benefits for each income class, the percentage distribution of these external benefits is computed.

shadow price of time is highest for the highest income class. Second, the highest percentage of automobile ownership is in the $15,000 and over income class.

In summary, it is possible to provide an approximation to the income distribution effects resulting from reduced congestion. It is recognized that the data base on which these estimates are formed is not as strong as might be desired. Despite these qualifications, we are convinced that inclusion of these effects substantially strengthens our estimates of the benefit incidence of public transit subsidies.

PART V: Conclusion

In this chapter, alternative approaches to benefit incidence have been examined. It has been shown that these approaches can be related to a common theoretical foundation. Secondly, the relationship between the elasticity approach and the marginal utility of income approach makes it possible to utilize the growing empirical literature on demand elasticities to allocate the benefits from public goods.

An attempt has also been made to determine the benefit incidence of two municipal expenditures, public transit and welfare payments. It appears feasible to utilize the theory of benefit incidence for each of these quite different expenditures. In future chapters, this methodology is used to determine benefit incidence in some of the balanced-budget fiscal experiments which we perform.

Chapter 5

Federal Revenue-Sharing Experiments

Having endowed our model with the ability to "talk", we present our empirical findings on the incidence of the eleven basic, federal revenue-sharing experiments described in the first chapter. In the rest of this chapter, we elaborate on our major conclusions for this group of experiments, which may be summarized along the following lines:

(1) A proportional expansion in local government expenditures has a progressive impact on the distribution of income or welfare (or, to be more exact, a U-shaped incidence profile) if they are financed by an increase in the corporate income or property taxes. Progressivity is more plainly visible if the source of finance is, instead, the individual income tax. Only if the benefits from local public services were dramatically pro-rich would it be necessary to qualify this conclusion.

(2) The expenditure effects of a personal income tax-financed transfer of funds to lower income groups serve to dampen the progressively redistributive nature of the initial, tax-transfer change, but only to a very slight extent.

(3) Use of the personal income tax to subsidize expanded levels of urban transit services has no discernible impact upon the structure of relative prices outside of the transit sector. Transit services, it will be recalled, were chosen in order to illustrate the impact of a specific purpose grant. The benefits of a reduced price for transit services accrue, in large part, to lower income groups who are also lightly burdened by the income tax. On the other hand, the external benefits of increased transit use are captured mainly by the upper

income groups. On balance, there is a progressive redistribution of income.

(4) Greater reliance on the corporate income tax to finance urban transit subsidies will lead to a progressive redistribution of both nominal and real incomes if external benefits are left out of account. Both the distribution of external benefits and the real income gains of a reduced transit price are unaltered by switching to this alternative source of finance. Despite some redistribution of income from the top to the bottom income group, the main feature of this experiment is the absence of significant income redistribution.

(5) Replacement of a portion of the revenues from the non-residential property tax, with the proceeds from a higher corporate income tax rate, has a more or less proportional, or neutral, effect on the distribution of both nominal and real incomes. Very little redistribution emerges in this case either.

(6) Using the revenues from an increased individual income tax to finance either consumer subsidies on the purchase price of housing, or a reduction in the residential property tax, causes an unambiguous shift in the redistribution of after-tax income in favor of lower income groups. There are two countervailing tendencies at work in this situation. The distribution of nominal incomes, before the income tax is applied, becomes more unequal than before, but this tendency is more than countered by the progressive weight of the income tax and the value of the lower housing prices to the poor, so that, on balance, after-tax real incomes are less dispersed than in the initial situation.

(7) If the target of the subsidy is switched from housing services (an output subsidy) to the use of land in housing (an input subsidy), the price of land will rise by almost the full amount of the subsidy. If the land subsidy is financed by the income tax, incomes will be distributed somewhat more equally than before (the subsidy is mildly progressive), since income derived from land ownership is less concentrated than the distribution of the personal income tax.

(8) Our results on the international incidence of Canadian tax policy are mixed. The personal income tax has almost no foreign repercussions. However, the two capital income taxes, the corporation income tax and the property tax, induce significant exporting of their burdens. Nonetheless, even in the case of these taxes on capital income, well over one-half of the tax burden is borne by the domestic economy. Although we feel that policy-makers should concentrate on the domestic effects of tax policies, the possible exporting of burdens should not be overlooked entirely. Further, much more work needs to be done on measuring foreign demand elasticities for Canadian exports and the international mobility of physical capital to achieve a more accurate estimate of the exporting of domestic taxes. Regardless of the assessment of the importance of tax burden exporting, the fact remains that the capital market and trade links to the rest of the world help to shape the impact of domestic taxes on national tax incidence.

(9) While our estimates of the national incidence of various fiscal experiments are not wholly insensitive to the alternative assumptions concerning parameter values, the results are on the whole

surprisingly robust. There is no conclusion mentioned above that is either overturned or requires severe qualification if any of the previously discussed parameter adjustments are made. Although we obviously cannot examine all of the possible combinations of parameters permitted by our model, we are confident that our conclusions would survive almost any reasonable revision of parameter values. Whether our results would be insensitive to the assumption of alternative structural relationships, that is, a different model, is, of course, another, and more open, question that is difficult, if not impossible, to answer.

Where our results are weakest is in the area of benefit incidence. This relatively unexplored aspect of fiscal incidence is something that deserves a higher priority in future work. Although we have tried to establish plausible bounds to the distribution of benefits in specific cases, the limits remain so disturbingly wide, in all cases, that it is impossible to render a final, and precise, assessment of the redistributive impacts. In the experiments we have conducted, accounting for benefits invariably weakens the progressivity of any given fiscal change.

PART I: A Guide to Interpreting the Results

Because of its size and complexity, our model does not lend itself to an analytical solution which allows one to "see" directly the interplay of various influences which combine to determine any particular solution. However, on the basis of insights gleaned from similarly structured, but simpler, models, one can make highly educated guesses to explain certain results. Two types of effect are, in particular, worth distinguishing. Factor taxes, such as the corporate income or property tax, will ordinarily have substitution effects on factor demand. That is, an increase in a factor tax raises that factor's cost relative to the cost of other factors and induces producers to substitute less expensive factors for it. The extent of the consequent reduction in the demand for the taxed factor depends directly on the size of the elasticity of factor substitution in the sectors where the taxed factor is employed.

In addition to this "substitution" effect, all kinds of taxes, factor and product, ordinarily have significant "output" effects.[1] Tax changes, by altering the costs of producing or purchasing different commodities, will modify the composition of output in the economy to a degree that depends on the price responsiveness of consumers to relative product price changes. The impact on factor prices of a new composition of outputs is conditioned by the magnitude of intersectoral differences in factor intensity (as measured by the variance of factor shares). For example, if tax changes encourage the expansion of relatively capital intensive sectors in the economy, the price of labor, relative to capital, will tend to fall. Generally speaking, the prices of factors, used intensively in the production of outputs that grow with respect to the rest of the economy, will be higher relative to other factor prices. Only if factor intensities were identical for each output would these output effects be unimportant. In our model, only the services of the housing sector and local government have a capital share of income that is noticeably different from the other sectors in the economy. Thus, output effects are never that important in explaining changes in capital's relative price unless the size of the housing or local public sector is significantly changed by the fiscal experiment. Land is an exception since some sectors do not employ any land in our model. Not surprisingly, then, the relative price of land, compared to labor, fluctuates a great deal more than does the relative price of capital.

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[1] These terms originate with Peter Mieszkowski, "On the Theory of Tax Incidence", Journal of Political Economy, Vol. 75, No. 3, June 1967.

Since the share of land in total income is relatively small and the price of labor is chosen as our numeraire, the issue of tax incidence on the sources of income side -- or tax and expenditure incidence in the case of our balanced budget experiments -- turns on what happens to the price of capital and on who owns the capital stock. In conjunction with the income class-expenditure data shown in Tables 3-8 and 3-9, these factor price changes, along with any output taxes or subsidies, translate directly into product price changes and, thus, determine incidence on the uses-of-income side. For the balanced budget experiments in which they are relevant, all of the measurements of benefit incidence draw on the discussion and tables from the previous chapter.

Although our main emphasis is on changes in the size distribution of income, it is also possible to infer what effect a new fiscal environment has on the functional distribution of nominal income. As a matter of definition, if the estimated decline in the nominal after-tax income earned by capitalists is equal to the higher tax revenues collected by government, owners of capital may be said to bear all of the tax. Similarly, if capitalists' income falls by less (more) than this amount, owners of capital share the tax burden with workers (lose income to workers). If there is no change in the after-tax income of capitalists, all factor groups may be said to share in the tax burden in proportion to their initial incomes. For some of our balanced budget experiments, a comparison can be made between the change in nominal capital income and the associated change in government revenues. This comparison, however, does not indicate how real incomes of different factor groups are affected since it ignores incidence on the uses side of income altogether. As a related point, many of our experiments imply changes (more frequently, declines) in the overall price level, so that the nominal income gains or losses experienced by different factor or income groups do not coincide with the real income adjustments that occur (they are usually smaller in size). Where relevant, the appropriate comparison is between government revenues and the change in real private incomes. Even here, however, the comparison provides only a rough indicator of incidence since induced revenue changes and foreign, or excess, burdens will also affect private real incomes.

In Chapter 3 some concern was expressed over the accuracy of the available data on the distribution of capital ownership in Canada. In Table 3-7 (and as more fully explained in a footnote to that table) we have adjusted the Statistics Canada series on net worth by income group so that it conforms more closely to information on capital ownership in the United States, which we believe is more likely to describe the true picture of asset holding in Canada. The primary impact of this adjustment is felt in the bottom income group where the share of total net worth is reduced from about .09 to .04. We have distributed this reduced share more or less proportionately across the remaining income classes except for the very top group. This procedure may very well understate the real concentration of capital income in Canada, especially since our series depicts the top income class owning a substantially smaller share of the economy's capital stock (26 per cent) than comparable data indicates is true for U.S. capitalists (40 per cent).[2]

We have tried to ascertain the reasonableness of our revision to the capital ownership data by inferring what this distribution must be from other data. As will soon be seen, our adjustment affects only the degree of any estimated redistribution and not the direction. An identity serves as a helpful check on our adjustment procedure. Let KY_i, LY_i and I_i denote the amount of capital, labor and total income earned by the i'th income class. Variables without subscripts represent the corresponding totals for the whole economy. Finally, let θ_i be the share of the i'th income class in total earned income. We then have: $KY_i/KY \equiv \theta_i (I/KY) - (LY_i/LY) (LY/KY)$.

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[2] For data on U.S. capital ownership, see Richard A. Musgrave, et al., op. cit., 1974.

From Table 3-8 it can be deduced that LY/KY = 2.81 and that I/KY = 3.8. For the distributive series pertaining to θ_i and LY_i/LY we rely on the Statistics Canada income distribution survey as reported by Maslove.[3] In Table 5-1 a comparison can be drawn between the distribution of capital ownership as shown previously in Table 3-8 and that which relies for its construction on the identity shown above. It is readily apparent that the two series are in reasonably close agreement except at the very top, where the alternative series gives a much higher share than the one we have used. Most of this higher share derives from an approximately proportional lower share attributable to the remaining income classes, except for the group at the very bottom where the two estimates coincide.

Regardless of the choice of measurement for the distribution of capital ownership in Canada, it will be true that the incidence of a tax borne by capital income will be U-shaped, reflecting the relatively high percentage of income received from capital ownership in both the lowest income brackets (under $5,000 in income) and the highest income range (over $15,000 in income). In the lower income groups there is a substantial number of older people, many of whom are retired, who receive a large fraction of their income in the form of interest and dividends and especially in kind from the imputed value of the service flows attributable to home ownership. Since age is an important dimension of membership in the lower income groups, it would be highly

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[3] See Allan M. Maslove, op. cit., p. 168.

Table 5-1

Alternative Estimates of Capital Ownership

Income Class	First Estimate (Table 3-7)	Second Estimate
under $3,000	.04	.043
3,000- 3,999	.051	.04
4,000- 4,999	.053	.047
5,000- 5,999	.054	.044
6,000- 6,999	.06	.069
7,000- 7,999	.06	.05
8,000- 8,999	.08	.05
9,000- 9,999	.085	.054
10,000-10,999	.065	.054
11,000-11,999	.07	.063
12,000-14,999	.13	.12
over 15,000	.26	.36

Note: The first estimate is taken from Table 3-7 (p. 97), while the second one is based on the identity shown in the text.

desirable, in the future, to examine the distribution of income by separate age-groups. This step towards disaggregation might help to eliminate a disturbing conclusion reached by Podoluk in her analysis of the Canadian data on wealth ownership: that the lower the income level, the greater is the inequality in asset holding within the income class.[4]

The questionable accuracy of the existing data on capital ownership bears on the exact position or location of the U-shaped incidence profile of a capital tax burden, not on whether the profile is U-shaped or not. It follows from this discussion, moreover, that a tax borne by workers will possess an inverse U-shape. Therefore, we will modify the usual definition of a progressive tax in our study and designate a tax as "progressive" either if it displays a U-shaped incidence pattern or if it satisfies the traditional meaning.[5] In the same vein, we bend the normal definition of a regressive tax so that it behaves as the mirror image of our "progressive" tax.

In order to avoid an erroneous impression of precision in our incidence estimates, in many instances we have grouped adjacent income classes together in reporting our results. This has the effect of smoothing our incidence profile and eliminating some saw tooth edges in either a U-shaped or inverse U-shaped pattern of tax and expenditure incidence.

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[4] See J. R. Podoluk, op. cit.

[5] There is more to this semantic rearrangement than a desire for a convenient label. Many elderly people with a relatively low level of disposable income but a high share of capital income may have, in fact, enjoyed a relatively high "lifetime" income.

In each of our experiments we consider four plausible parameter "regimes" in which we alter either the elasticity of foreign demand for flexibly priced exports or the foreign capital supply elasticity. In the first regime, these parameters take on the values of minus one and zero, respectively. In the second regime, the capital supply elasticity, but only it, is adjusted to take on a value of unity. For the third case, the capital supply elasticity remains at one while the foreign-export demand elasticity is changed to a value of minus six. Finally, in the fourth export, the demand elasticity is changed to a value of minus six and the supply elasticity to minus three. One can conceive of these alternatives as portraying increasingly longer adjustment periods during which foreign consumers and capital owners increasingly react to Canadian fiscal changes. One can also determine how sensitive the results are to alternative specifications of the economy's supply of capital relationship.

The mobility of land between agricultural and housing uses is also allowed to vary within the range of .1 to one. Domestically owned capital and labor, on the other hand, are assumed to be perfectly mobile within Canada.

In the production of local government services, we have virtually no information on the nature of the production process which provides these services. *Faute de mieux*, we assume that the elasticity of factor substitution between labor and capital services is unity. We also select an arbitrarily small amount, $10, to represent the value of public sector capital income. This is undoubtedly an underestimate of this income stream and one which highlights the pressing need for more research on the labor intensity of the public sector. It may be true, as our model assumes, that a change in public sector output or services represents primarily a change in labor employment; much of the capital stock in the public sector - for example, structures - may qualify as fixed assets for our purposes. Only additional economic inquiry can determine the best directions for remodelling production behavior in the public sector.

Before turning to our individual experiments, it is desirable to elaborate briefly on how the transition from a statutory to an effective change in tax rates is made. For the most part, we consider the repercussions of a ten per cent increase in the statutory tax rate. As an example, suppose a ten per cent change in the corporate tax rate is being examined. From Table 3-2 in Chapter 3 we observe that the effective tax rate, in flexibly priced exports, E, is .276. If the statutory rate were 48 per cent, 4.8 percentage points would be added to this amount in the face of a 10 per cent statutory rate increase. The amount of capital in this export sector, subject to the income tax, is approximately .276/.48. Thus, the effective rate change on capital employed in this sector becomes the product .048 (.276/.48) or simply 10 per cent of the initial effective rate of .276. Note that this argument is valid no matter what value the statutory corporate tax rate takes on initially. By extension, effective rate changes in the other sectors are simply 10 per cent of whatever their initial effective rates happen to be.

When instead we manipulate the federal personal income tax, it should be understood that what we have in mind here is a federal income surtax which preserves the effective rate structure implicit in the personal income tax series of Table 3-7 and which also serves the institutional connection between the federal and provincial income tax yields (provincial income taxes are a specified fraction of the "basic" federal income tax yield). Finally, subsidies to the purchase price of housing and to the use of land in the housing sector are treated as reductions in the effective indirect tax applied to housing services and to the property tax rate on land in housing, respectively. The details of these particular tax changes are more fully described later on. With these important preliminaries out of the way, we present the results for each of the experiments that were carried out.

PART II: Incidence Results for the Various Experiments

Experiment (1): A 10 per cent increase in the federal corporation income tax rate to finance a proportional increase in local government spending.

The implications for income distribution of this particular fiscal change are set out in Table 5-2. In each of the four parameter regimes, the after-tax return to capital falls, relative to the price of labor, by an amount between 2.1 and 2.3 per cent. For example, if capital earned 8 per cent initially, it receives about 7.8 per cent after the tax change. Since the effective change in the tax rate is 2.6 and 2.8 per cent in the corporate and flexible price export sectors, respectively, the gross price, or cost, of capital becomes marginally higher in these activities. Everywhere else the gross price of capital declines in the new equilibrium. An increase in the relative cost of

Table 5-2

Experiment (1): A 10 per cent increase in the federal corporation income tax rate to finance a proportional increase in local government services.

5-2 a. Size Distribution
(millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	-1.1	-1.0	-.94	-1.4	.05	.13	.10	.17
3,000- 3,999	-1.0	-.95	-.92	-.94	-.67	-.60	-.67	-.71
4,000- 4,999	-.76	-.73	-.71	-.69	-.49	-.43	-.49	-.50
5,000- 5,999	-.57	-.55	-.53	-.52	-.33	-.29	-.34	-.36
6,000- 6,999	-.53	-.50	-.49	-.51	-.31	-.27	-.32	-.37
7,000- 8,999	-.48	-.46	-.45	-.46	-.28	-.25	-.30	-.34
9,000-10,999	-.52	-.50	-.49	-.53	-.36	-.32	-.36	-.40
11,000-14,999	-.53	-.50	-.49	-.51	-.38	-.34	-.37	-.38
over 15,000	-.67	-.64	-.62	-.65	-.56	-.51	-.54	-.58
all classes	-.59	-.56	-.55	-.57	-.39	-.44	-.39	-.43

5-2 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	-2.0	-.47	-2.0	$250.8	$108.1
(2)	-2.25	-.54	-.62	$254.6	$ 89.2
(3)	-2.2	-.47	1.14	$254.9	$ 80.1
(4)	-2.3	-.72	2.9	$259.9	$ 62.8

Notes: (a) If ε_1 and ε_2 denote the foreign export demand and capital supply elasticities respectively, cases (1)-(4) represent the following combination of parameter values:

Case 1: $\varepsilon_1 = -1$, $\varepsilon_2 = 0$;
Case 2: $\varepsilon_1 = -1$, $\varepsilon_2 = -1$;
Case 3: $\varepsilon_1 = -6$, $\varepsilon_2 = -1$;
Case 4: $\varepsilon_1 = -6$, $\varepsilon_2 = -3$.

For all of the cases, the land mobility parameter has a value of .2.

(b) In calculating percentage changes in nominal and real income, initial factor income of each income class is used as the denominator.

capital in these two large sectors induces producers to substitute labor for capital. This factor substitution response, coupled with an expenditure switch towards heavily labor intensive, local, government services, acts to depress the net-of-tax reward earned by capital. This depression in capital's return is moderated by an offsetting output effect in the form of an expansion of production in the less heavily taxed, but relatively capital intensive, agricultural and housing sectors.

In all of our experiments, it is the price of land used in housing and agriculture that behaves most erratically as different parameter regimes are considered. In view of what was said earlier about the importance of "output" effects in explaining the price behavior of land, this instability is not surprising. As shown in Table 5-2, the price of land tends to fall slightly in most instances. The price of land used in housing is invariably depressed by a small amount (.5 to .75 per cent), probably a reflection of the expenditure shift to government services, which use no land, and some ability to substitute capital for land when the gross price of the former declines. The same factors appear to be at work for land which is used in agriculture, except that when the foreign-capital supply elasticity increases, the price of agricultural land increases rather than declines.

We suspect that this reversal in the price behavior of agricultural land can be explained by appeal to two features of our model. Since the gross price of capital in the corporate sector increases, foreign capital enters Canada and, in increasing amounts, the larger is the capital supply elasticity. Since foreign capital is employed exclusively in the corporate sector, domestically owned capital departs from there to seek a higher net return in the noncorporate sectors of the economy, including agriculture.[6] At the same time, both domestic and foreign demand are shifting toward agricultural goods, as the lower gross price of capital in agriculture serves to reduce the price of this sector's output, enhancing its attractiveness to consumers everywhere. Moreover, the higher price of flexibly priced exports reduces their export value and causes, through the balance of payments constraint, a need for fixed price exports to pick up the resultant slack. Both of these supply and demand influences contribute to an expansion of agricultural output and create pressure for a higher land price. There may be, of course, other forces operating here; we have isolated only two of the most important influences.

Table 5-2 exhibits some of the detailed consequences of these factor price changes. In the lower portion of this table is shown the configuration of factor price changes for each of the different parameter regimes. By comparing the change in income for all income classes in the upper portion with the change in government revenue, it is possible to make some rough judgements about shifts in functional income distribution. The decline in real private capital income should be compared with the additional government revenues, recognizing that the latter magnitude is already implicitly stated in real terms in view of the preponderance of labor purchases in the public sector budget. Although the decline in real private incomes will not correspond exactly to the gain in public revenue, because of the presence of excess and foreign fiscal burdens, it is apparent that the increased revenue is obtained mainly at the expense of lower capital incomes. The corporate income tax, with funds spent in the manner specified, is essentially borne by capitalists, including landowners.[7] Within the range of values that we feel is warranted, this conclusion stands up no matter what value is assigned to the elasticity of foreign capital supply.

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[6] This is the first time, to our knowledge, that a plausible link has been established between Canadian corporate tax policy and the degree of foreign ownership in the corporate sector.

That this conclusion appears to be undisturbed by the value of the elasticity of foreign capital supply may seem surprising. Purely theoretical grounds tell us that the tax change will cause the gross-of-tax corporate rate of return to rise. Given an elastic supply of foreign capital, that price rise will induce an inflow of capital, raising the economy's capital-labor ratio and, in turn, lowering the net return to capital more than is the case when there is no inflow of capital. This general conclusion is borne out by our results. In case (1) the capital stock is fixed, while in case (2) the foreign supply elasticity is one and, consequently, the return to capital falls more in case (2). In case (3) the foreign supply elasticity is again one, while in case (4) it is raised to three. As before, the higher is the elasticity of foreign capital supply, the further the return to capital falls.

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[7] From Table 3-2 the weighted average tax change for all of the taxed commodities is .0202. Since the percentage decline in the net price of capital is of the order of -.021, owners of reproducible capital bear almost the entire brunt of the higher corporate tax rate. Landowners, as can be seen in Table 5-2, are very modestly worse off as a group from this particular tax change.

While the expected relationship between the foreign capital supply elasticity and the fall in the return to capital does hold, the figures in Table 5-2 suggest that the relationship is quite weak. However, this appearance is misleading because of our aggregation procedure. Each of the aggregate commodities in our model is partially produced by corporations. As a result, all sectors pay some corporation income tax, and an increase in that tax is partially an economy-wide, tax increase on capital. To understand the importance of this fact, consider the .025 increase in the tax in the corporate sector as occurring in two stages, an initial .012 increase in the tax on all capital, and then a .013 further increase in the corporate sector only.[8] The general tax increase of .012 causes the rate of return to fall by .012, leaving the corporate cost of capital unchanged; consequently, that part of the overall tax change induces no capital flow no matter what the foreign-capital, supply elasticity is. Only the surtax on corporate incomes can elicit capital flows. Netting out the effects of the .012 general tax rise, the extra .013 rise of the tax in the corporate sector lowers the rate of return by .09, when there is no foreign capital mobility-case (1), and by .11 when the capital mobility elasticity has a value of three-case (3). This constitutes a 22 per cent increase in the fall in the rate of return allowing for international capital mobility. (In fact, because we rounded off our results in Table 5-2, this figure underestimates the effect of capital mobility.) Clearly, the impact of capital mobility is not as unimportant as it seems to be at first glance.

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[8] The division between a .012 across-the-board tax increase and a .013 surtax on the corporate sector is only approximate. There was a different tax increase for each sector of our economy. The average increase for the predominantly non-corporate sectors is calculated to be about .012.

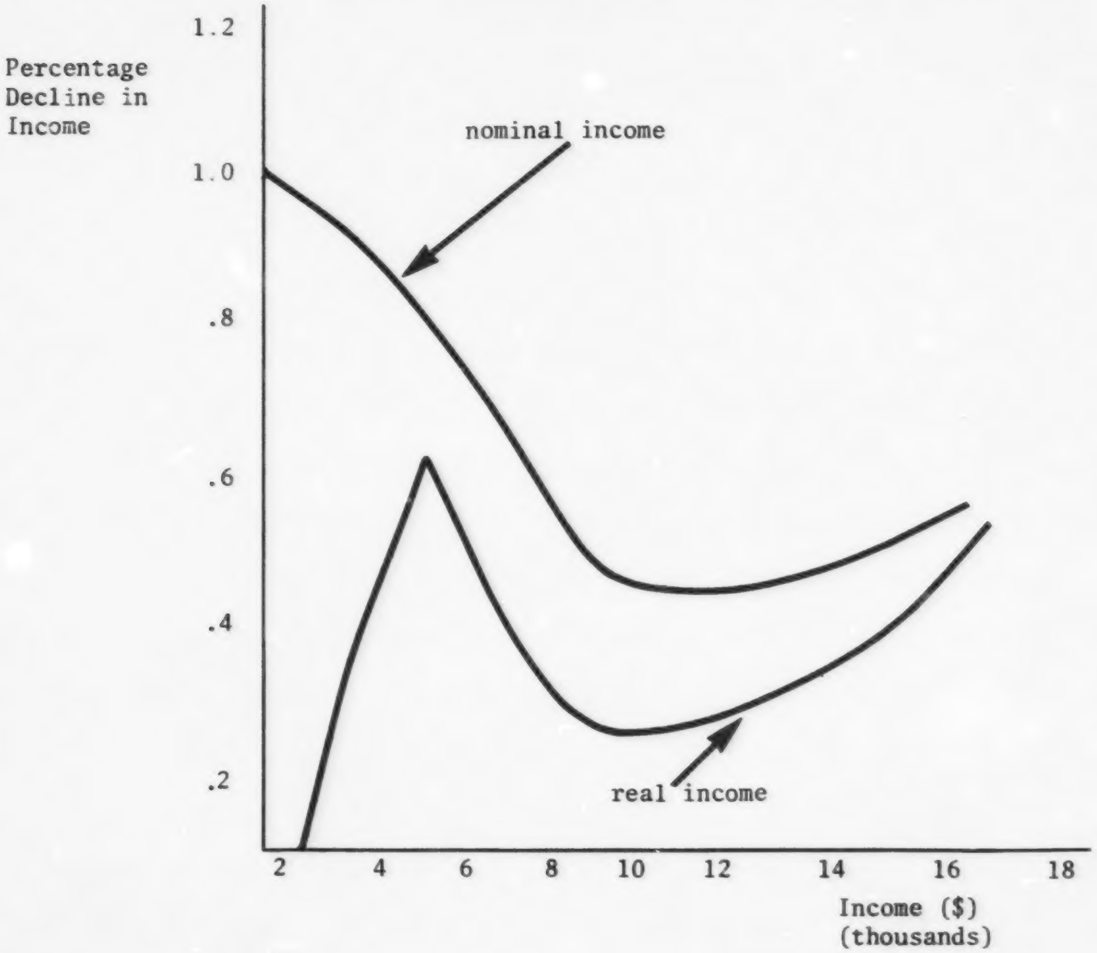
In the upper half of Table 5-2, this finding is translated into its effects on the size distribution of both nominal and real incomes. Notice that, due to a declining price level, the reduction in private nominal incomes overstates the reduction in real private incomes. Looking first at nominal incomes (the sources of income side), all income groups experience losses but some lose significantly more than others. Income groups earning less than $5,000 and more than $15,000 lose more, in percentage terms, than average; their relative income position worsens. The other income groups lying between these intervals find their relative income position improved. Thus, on the sources side of incidence, the redistributive profile is U-shaped and we have defined this pattern previously to be one that is progressive.

This picture, however, is slightly modified when the uses side of incidence is taken into account along with the sources side. First of all, the poorest income group enjoys a very modest increment in real income since the relative prices of the two items with the largest weights in their budgets, housing and food, decline. For the remaining income groups, these two expenditure items decline in importance as income rises, so that the highest income groups face the heaviest burdens in the uses side. As shown in Figure 1, the incidence profile for real income changes is again U-shaped, ignoring the bottom group, but it

Figure 1

Effective Tax Rates by Income Class for

A 10 Per Cent Income in the Federal Corporation Income Tax



Note: The values shown in Figure 1 correspond to those of case (2) in Table 5-2.

tilts upwards with a steeper slope than that for nominal incomes does, indicating a greater degree of progressivity than before, and also has a flatter mid-range than the relationship for nominal incomes.[9] Generally speaking, for income groups earning less than $5,000, the absolute difference between the percentage change in their real incomes and the percentage change in real income for all groups is less than if a similar comparison were made on the basis of nominal income. For income groups earning in excess of $5,000, the opposite is true. In summary, inclusion of incidence effects on the uses of income side modifies this first experiment's progressive impact on income distribution only to a very small degree.

Another interesting policy question concerns the international fiscal incidence of this prospective change. In Chapter 2 it was seen that the induced change in real Canadian incomes, working through the balance of payments connection with the rest of the world, was $dR = V_E \hat{P}_E + \hat{P}_F (V_F - V_M) - V_{Kf} \hat{P}_K$. In Chapter 3 it was found that V_E = \$9,024 mn., V_F = \$1,848 mn., V_M = \$9,789 mn., and V_{Kf} = \$1,083 mn. With these values and the calculated output price changes derived as functions of the given tax change and the endogenous factor price changes, the foreign burden (or benefit) of Canadian fiscal changes can be estimated for each alternative set of parameters. These estimates are also shown in Table 5-2 and indicate a small gain for Canada in every instance, an increase which is of the order of one-eighth of one per cent of Canadian GNP ($70,345 mn.) and between 25 and 43 per cent of the tax revenue collected.

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[9] In all studies of tax or fiscal incidence, a choice must be made concerning the appropriate income base which forms a part of the incidence estimate. In the terminology of Gillespie and Maslove, our choice of this base to be factor incomes (total income before income taxes, excluding transfer payments) corresponds in spirit to the concept of "broad" income, or income in the absence of government. We chose this concept because our fiscal experiment operates to change pre-tax and pre-transfer factor incomes. However, an argument could be made in favor of using disposable income since it is this base which defines a household's initial level of welfare. If this base were adopted instead, the U-shaped incidence profile would remain, although it would stand out in less sharp relief than is suggested by Table 5-2.

All three of the terms in the preceding fiscal exporting formula contribute to this gain in real income. The prices foreigners pay for flexibly priced exports increase since the tax increase raises the cost of capital by more than the decline in capital's net price reduces it. Moreover, there is a tiny appreciation in the exchange rate which lowers the real purchase price of imports, and this gain more than compensates for the lower real incomes earned in the production of fixed price exports. In addition, the fall in the after-tax return of capital diminishes the real income claims of foreign capitalists on the Canadian income stream. In general, however, there is no necessity for each of these terms to move in the same direction.[10]

There is a further dimension to fiscally exported burdens which should be recognized. While the previous discussion has emphasized the international incidence of national policies, it is worth keeping in mind that national policies also have a regional or provincial incidence. To the extent that a higher corporate income tax raises the relative price of corporate output, as it does in our model, the interregional terms of commodity trade will deteriorate for regions which are net importers of corporate output. These regions will become relatively worse off compared to regions which are net exporters of corporate output to the rest of Canada. Because of our national perspective, this interregional redistribution of income is not taken into account in any of our calculations. Nonetheless, it still exists and could become an important item in some policy discussions.

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[10] It should be mentioned here that our estimate of the foreign fiscal burden may be overstated since we have implicitly assumed that foreigners do not receive any benefits from local government services, that is, we assume that there are no benefit exports. This is another area begging for more research.

Another feature of our approach to the exporting of fiscal burdens deserves further comment. As mentioned in an earlier chapter, we assume in our study that the marginal costs of capital rise by the amount of any change in the corporate rate. For most firms in the economy this may be an eminently reasonable assumption. But what about multinational firms that invest directly in the Canadian economy? The marginal cost for the marginal, multinational firm must be the same as the gross return to capital in the corporate sector, or else it would not find direct investment worthwhile. For the inframarginal firm, however, its higher tax payments to the host country can be offset, within wide limits, by reduced tax liabilities payable to the home treasury. It seems that the marginal cost of capital to firms in this position are independent of changes in the Canadian corporation income tax. If this were indeed true, Canadian firms in the corporate sector would be strongly disadvantaged by increases in this tax rate and we would need to adjust our description of the corporate sector by disaggregating it into its domestic and foreign components. However, it is probably unnecessary to carry matters that far. While double-taxation treaties may leave the average cost of capital for inframarginal multinationals unchanged, the financial mobility of stockholders means that their marginal cost will likely rise *pari passu* with the corporate tax rate. That is, if marginal, direct investors earn a higher gross (and net) return on capital employed in Canada, stockholders will sell their shares of inframarginal firms until they get the same return from both kinds of firm. As a result, the gross return of marginal foreign firms should also determine the marginal cost of capital that is perceived by inframarginal firms.

In the previous chapter it was suggested that the benefits from local public services rise either proportionately, or more than proportionately, with income levels. For this first experiment, the situation is one in which the upper income groups pay relatively high taxes in order to finance the provision of public goods that are of especially high value to themselves. The redistributive impact of higher corporate taxes, including expenditure of the tax funds, is at least partially cancelled by the progressive nature of the benefits that they serve to finance. When all aspects of fiscal incidence are considered, this budgetary operation may result in little or no redistribution of economic welfare among income groups (although substantial redistribution could conceivably occur within these groups).

Because of our inability, at least for the moment, to obtain reasonably reliable estimates of benefit incidence for all local expenditures, we refrain from making an explicit calculation of fiscal incidence and refining our qualitative evaluation of the overall distributive impact associated with this first experiment. It is, however, worthwhile briefly discussing exactly how one could compute fiscal incidence if accurate information on the distribution of benefits were available. The first matter of concern is the size of the total benefits "package" to be distributed, or the aggregate valuation that is placed on the public good. An attractive option is to assume an efficient level of provision and constant average costs of provision which permit total benefits to be equated with total public sector expenditures. Alternatively, either or both of these assumptions could be relaxed and total benefits allowed to differ from total costs.[11] Whatever procedure is followed, assume that total benefits to be distributed are given as the amount \$Z. If benefits received are proportional to income, the benefit allocated to any particular income group, B_i, is given by the expression $B_i = Y_i \; (\$Z/\sum_{i=1}^{n} Y_i)$, where Y_i is the income (factor or disposable income received by the i'th group in an economy comprised of n different income groups). In this particular case, the ratio B_i/Y_1 is a constant. If, on the other hand, the elasticity of benefits received with respect to income were 1.5 rather than the one, the benefit-income ratio between adjacent income classes (the i'th and the j'th) would be represented by: $B_i/Y_i = 1.5 \; B_j/Y_j$ where $Y_i > Y_j$ and for the lowest income group, its benefit B_1 is normalized such that $\sum_{i=1}^{n} B_i = \$Z$.

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[11] Using a median voter model, Barlow, op. cit., calculates that local education in Michigan may be "underprovided" by about 17 per cent. This conclusion is reached by comparing the marginal benefits and tax costs for the median voter.

These calculated values for B_i would be directly additive to the income gains and losses shown in Table 5-2. For example, if benefits were proportional to income, the percentage increment in the real income of each income group would be .4. Thus the upper income group in this case would receive benefits worth about $46 mn. Households in this income bracket would experience a negative fiscal residual as the value of these benefits is less than the real income losses suffered on the tax and expenditure side of the incidence ledger. Most of the other groups would enjoy a small but positive fiscal residual; for example, benefits for households in the $6,000-$6,999 range would be about $13.2 million, resulting in a net fiscal gain of about $1.5 to $2 million. Of course, if benefits were distributed more than proportionately to income, little or no fiscal redistribution would occur. For example, if the benefit-income elasticity was 1.5, real income for the top income group would increase by .65 per cent. The outcome is quite sensitive to the availability of accurate measures of benefit incidence.

As emphasized in the previous chapter, there is a time dimension to benefit incidence which depends on how mobile people are in response to differential changes in access to the enjoyment of public goods. These responses determine whether the initial recipients of the benefits of public goods eventually relinquish them to other groups through the process of land value capitalization. The expansion in the level of public goods envisaged by the first experiment is of a general nature and should not affect land values between any two urban centres.

However, it is not a perfectly general change since it does not apply to the relatively small (in terms of population) nonurban areas of the economy. Accordingly, there will be some tendency for urban land values to rise relative to values at nonurban sites, and the strength of this tendency will depend on the stimulus to urban migration provided by the higher level of local public goods. Not surprisingly, the general improvement in urban amenities should accelerate the well-established trend in the direction of increased urbanization.

Experiment (2): A 10 per cent increase in the property tax to finance a proportional increase in local government expenditures.

In this experiment we switch the source of finance but retain the same expenditure goal, although the amount spent is not the same as in the previous experiment. As can be seen from Table 5-3, the impact of the experiment does not differ markedly from the results of the previous experiment. This is not too startling since we are, in effect, replacing one capital tax with another capital tax. While the income distribution effects are very similar, the underlying adjustment processes are quite different in the two cases.

With the higher corporate income tax, a relatively larger amount of capital became employed in the noncorporate income tax. The property tax rate, however, is higher in the noncorporate sectors (housing and agriculture) so that a higher rate acts to divert capital into the lower taxed corporate sectors. Heavier taxation of a mobile factor in one of its uses drives down its return in more lightly taxed activities. This tax-diffusing effect is perhaps the central implication of modern tax incidence theory. For a 10 per cent higher property tax, net price

Table 5-3

Experiment (2): A 10 per cent increase in the property tax to finance a proportional increase in local government services

5-2 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	-.73	-.88	-.94	-.87	-.79	-1.07	-.77	-.73
3,000- 3,999	-.69	-.60	-.64	-.60	-.69	-.59	-.50	-.47
4,000- 4,999	-.53	-.44	-.47	-.44	-.49	-.44	-.36	-.34
5,000- 5,999	-.40	-.33	-.35	-.33	-.35	-.33	-.26	-.24
6,000- 6,999	-.37	-.33	-.35	-.33	-.32	-.33	-.26	-.24
7,000- 8,999	-.33	-.30	-.32	-.30	-.29	-.30	-.21	-.22
9,000-10,999	-.37	-.33	-.35	-.33	-.31	-.31	-.26	-.26
11,000-14,999	-.36	-.33	-.35	-.32	-.30	-.34	-.26	-.29
over 15,000	-.46	-.42	-.45	-.42	-.40	-.39	-.37	-.35
all classes	-.41	-.37	-.39	-.36	-.35	-.35	-.30	-.28

5-3 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	-1.5	-4.6	-3.0	$195.9	$42.4
(2)	-2.2	-4.7	-4.7	$191.8	$56.2
(3)	-1.3	-4.6	-6.7	$191.7	$72.8
(4)	-1.1	-4.6	-8.4	$187.7	$93.6

Notes: The parameter values for cases (1)-(4) are described both in the text and in the note to Table 5-2.

of capital declines by between 1.1 and 1.5 per cent, depending on the size of the foreign capital supply elasticity. In this case, the percentage decline in the net return to capital is larger than the corporate sector tax increase. The gross rate of return to corporate capital is therefore diminished and foreign capital leaves the country. The more capital that departs, the less depressed is the net return to capital. Viewed from another perspective, the higher the foreign supply elasticity, the more readily Canadian-owned capital finds reemployment in the corporate sector and the smaller is the reduction in the net return on capital.

In all four instances examined, however, the net price of land used in agriculture and housing falls noticeably (from 3 to 8.5 per cent) although by less than the tax increase of 10 per cent. The reason behind this reduction in received land rents is straightforward. First of all, there is an expenditure shift toward the public sector which uses no land. In addition, the relative cost and price of land-using noncorporate sectors increases, causing a contraction in consumer demand for noncorporate output. This "output" effect is also unfavorable to land, and both the expenditure and output effects are reinforced by a tendency to substitute labor for the taxed and higher cost land and capital. Comparing the change in aggregate real private incomes to government revenue, it is clear that capital (inclusive of land) bears the fiscal burden in the first two cases. However, in the last two cases, in particular where foreign capital supply elasticity is largest, a tiny portion of the fiscal burden is also borne by labor as the decline in real capital incomes is less than the additional tax revenue.

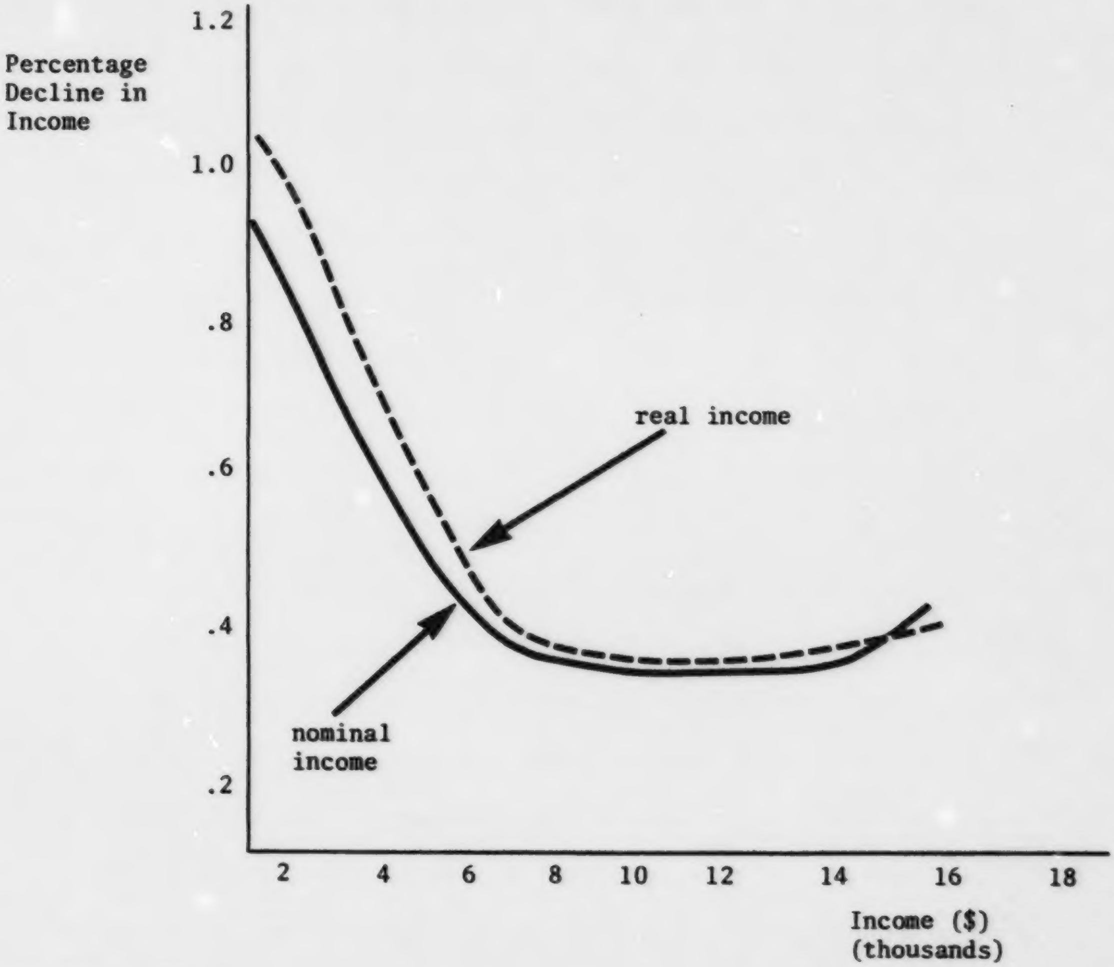
This is to be expected since, the more mobile capital is, the greater is the prospect of shifting the burden of a capital tax onto immobile labor. Alternatively, the greater the decline in the aggregate capital-labor ratio in the economy, the greater is the burden borne by labor.

With regard to the size distribution of income, the same type of U-shaped incidence profile emerges as in the first experiment; this is described in Figure 2. The main difference is that the profile has a gentler slope than before -- it is almost proportional in the middle income range. Income groups earning more than $15,000 and less than $5,000 bear a disproportionately high fiscal burden, while the middle income groups carry a proportionately lighter load (the bottom of the "U" is reached at $7,000-8,999 in annual income). Because of a small drop in the aggregate price level, the decline in total real private income is smaller than that for nominal incomes. The extent of the redistribution is accentuated for real income, since the income groups with less than $5,000 in income spend a higher than average amount of their budgets on noncorporate output, the relative prices of which have risen. Both this and the first experiment contradict "Director's Law", the hypothesis that the middle income class loses to the benefit of both the top and bottom income groups.

The foreign fiscal burden increases in every case and is higher in each successive case. The prices of both types of export good decline as does the after-tax claim of foreign capitalists. The major benefit to Canada is in the form of a small exchange rate appreciation which reduces the real purchase price of imports.

Figure 2

Effective Tax Rates by Income Class for A 10 Per Cent Nationwide Increase in Property Taxes



Note: The values shown in Figure 2 correspond to those of case (2) shown in Table 5-3.

The capstone on this story of fiscal burdens, depends, as always, on the nature of benefit incidence. As previously discussed, benefits probably favor the upper income groups, but to a degree that is still largely unknown. Assume that total benefits approach the amount of revenue and that benefits vary proportionately with income. Under these circumstances, the highest income group would enjoy benefits worth about $45.5 mn., an amount which nearly coincides with the real income losses sustained by this group in Table 5-3. Thus, it again appears that there is probably very little redistribution occurring through the budgetary changes envisioned by this second experiment.

Experiment (3): A 10 per cent increase in the federal personal income tax to finance a proportional increase in local government spending.

The implications of this experiment, as shown in Table 5-4, are reasonably straightforward. Because of the expenditure shift toward labor-intensive, government services, the relative prices of the factors used intensively in the production of private sector goods, land and capital, decline. The decline in the price of land is much larger than that for capital. As the gross rate of return or cost of capital in the corporate sector is diminished, there is some tendency for capital to leave Canada. This response on the supply side of the capital serves to cushion the decline in capital's net return, as can be seen in Table 5-4 by comparing the first and fourth cases.

The impact of these factor price changes is to provide some small reinforcement for the progressivity of the individual income tax. By themselves, the changes in factor rewards introduce the U-shaped

Table 5-4

Experiment (3): A 10 per cent increase in the federal personal income tax to finance a proportional increase in local government services.

5-4 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income (1)	(2)	(3)	(4)	Percentage Change in Real Income (1)	(2)	(3)	(4)
0- 2,999	-.99	-1.01	-1.03	-.99	-.11	-.31	-.20	-.25
3,000- 3,999	-.81	-.76	-.76	-.73	-.63	-.47	-.46	-.47
4,000- 4,999	-.98	-.94	-.95	-.93	-.70	-.70	-.70	-.70
5,000- 5,999	-1.1	-1.1	-1.1	-1.1	-.91	-1.0	-.93	-.88
6,000- 6,999	-1.26	-1.26	-1.26	-1.25	-1.04	-1.07	-1.04	-1.07
7,000- 8,999	-1.4	-1.4	-1.4	-1.35	-1.18	-1.19	-1.2	-1.19
9,000-10,999	-1.5	-1.5	-1.5	-1.5	-1.34	-1.36	-1.35	-1.35
11,000-14,999	-1.7	-1.68	-1.69	-1.67	-1.52	-1.53	-1.52	-1.51
over 15,000	-2.34	-2.33	-2.33	-2.34	-2.19	-2.2	-2.2	-2.2
all classes	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.

5-4 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	-.28	-1.3	-3.9	$894.7	$39.9
(2)	-.14	-1.25	-4.3	$893.6	$42.6
(3)	-.16	-1.27	-4.9	$893.5	$47.9
(4)	-.08	-1.25	-4.9	$892.3	$56.8

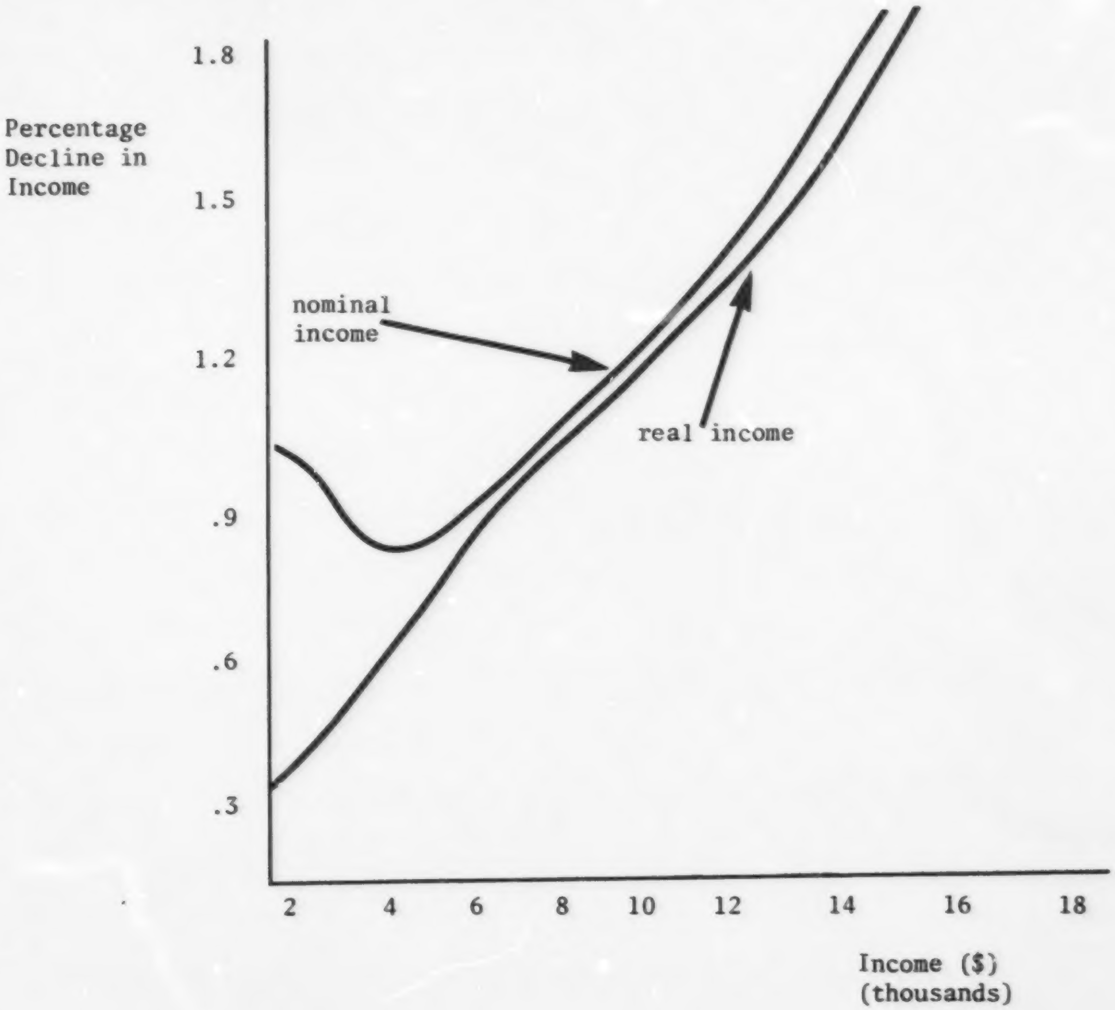
Note: For a description of the parameter values in cases (1)-(4), see Table 5-2.

incidence profile that was encountered in the previous experiments. The income tax, however, acts to "iron out" this profile and to impose, according to Figure 3 a "truly" progressive pattern of fiscal burdens in which the percentage reductions in income increase with higher income (overlooking the small "wobble" at the bottom). Essentially, because the individual income tax is independent of the source of income, only income groups earning more than $11,000 annually undergo a larger than average fiscal sacrifice. Moreover, the progressivity in the redistribution of real incomes is larger than that for nominal incomes since the relative prices of housing and food products, which bulk larger in low income budgets, are reduced when land and capital prices decrease relative to labor. The dividing line of $11,000 income is, nonetheless, unaffected by a shift in focus from nominal to real income changes. Overall, the results of this experiment are not in the least sensitive to the choice of parameter regime.

In each of the cases examined there is some exporting of fiscal burdens to foreigners; the amount of the loss sustained by foreigners is between $40 million and $57 million. This loss is the net result of offsetting forces in the terms of international trade. The world price of flexibly priced exports diminishes but this loss to Canadians is more than compensated for by a larger decline in the world price of fixed-price exports and imports. The overall gain to Canada occurs largely from the appreciation of the exchange rate and only secondarily from the lower after-tax returns received by foreign capitalists.

Figure 3

Effective Tax Rates by Income Class for A Ten Per Cent National Increase in Personal Income Taxes



Note: The values shown in Figure 3 correspond to the values of case (2) shown in Table 5-4.

When benefits are considered, the issue of fiscal incidence is once more clouded by the uncertainty about the appropriate size and distribution of benefits. If benefits are valued "at cost" and their distribution is proportional to income earned before personal taxes and transfers, all income groups would receive benefits worth an increase of 1.58 per cent in their real incomes. All groups earning less (more) than $11,000 annually would experience a positive (negative) fiscal residual. Of course, if benefits are captured in disproportionate amounts by high income groups, there is again probably little or no redistribution occurring through the budget.

Experiment (4): A 10 per cent increase in the federal corporate income tax to finance an increase in transfer payments to the poor.

In this experiment, tax revenues are spent in a particular, rather than a general, direction. Extra funds from a higher rate corporate income tax are used to augment the transfer payments received by the poor. Since even very well-designed transfer programs are characterized by some seepage of revenues to upper income groups, we assume that less than perfect target efficiency is achieved and allocate transfers according to the distributive series for all transfers shown in Table 3-7.

As was seen in Table 5-5, the impact of this tax-transfer program is a reduction in the relative net return to capital, a slightly lower land rent in housing and an unusually higher rent for land used in agriculture. On the whole, these results closely resemble those observed in the first experiment (see Table 5-2). It is apparent that the expenditure shift to the labor intensive, government sector has a

Table 5-5

Experiment (4): A 10 per cent increase in the federal corporate income tax to finance an increase in transfer payments to the poor.

5-5 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	2.05	2.1	2.1	2.1	2.3	2.3	2.20	2.2
3,000- 3,999	.62	.65	.69	.69	.89	.82	.70	.79
4,000- 4,999	.24	.25	.26	.26	.49	.46	.42	.42
5,000- 5,999	.06	.09	.12	.12	.33	.30	.23	.24
6,000- 6,999	.00	.04	.06	.06	.28	.21	.17	.16
7,000- 8,999	-.12	-.10	-.07	-.07	.04	.06	.05	.04
9,000-10,999	-.32	-.28	-.25	-.25	-.17	-.14	-.17	-.17
11,000-14,999	-.35	-.36	-.28	-.28	-.20	-.18	-.21	-.21
over 15,000	-.58	-.53	-.53	-.53	-.43	-.43	-.43	-.42
all classes	-.07	-.04	-.00	-.00	-.12	-.12	-.09	-.09

5-5 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	-2.0	-.03	-.80	-	$-94.8
(2)	-2.2	-.11	.70	-	$-82.4
(3)	-2.2	-.03	2.6	-	$ 65.3
(4)	-2.3	-.16	4.35	-	$ 49.5

Note: (1) For a description of the parameter values in cases (1)-(4), see Table 5-2.

(2) Since the intent is to raise the existing incomes of the poor, disposable income of each income group is used as the base for calculating the percentage changes.

small role to play in explaining the factor price changes of the experiment. The source of the tax funds is more important in determining incidence than the manner in which they are spent. This is a further indication that output effects are relatively unimportant in the model.

The higher rate of tax induces employers to substitute other inputs for capital and this depressing effect on the return to capital is not offset by other effects working through the change in the composition of total output. Both an income and substitution effect in consumption favor the expansion of the relatively capital intensive housing and agricultural sectors. First, the poor, who receive the bulk of the transfers, spend a relatively high proportion of any incremental income on the output of these two sectors. In addition, their cost of capital rises by less than it does elsewhere, leading consumers in every income class to buy more of their output. However, both of these demand effects are extremely weak in raising the relative return to capital.

Supply adjustments tend to mirror the changes in fiscal demand. Capital and labor resources flow into production of the less heavily taxed outputs of H, A and particularly F. Within the agricultural sector, some land is shifted from the production of domestic output to exports (F), while agriculture as a whole receives a small amount of land relinquished by the housing sector. In the production of housing services, relatively cheaper, reproducible capital is substituted to some extent for land. In the corporate sector, the gross price of capital rises, attracting more foreign capital and displacing some domestically owned capital to the production of noncorporate output.

The lower price of capital is offset only partially by the higher land return so that these induced, factor price changes reinforce the intent of fiscal policy to redistribute income to the poor. For nominal incomes changes, those earning more than $6,000 annually are taxed to pay for transfers to those earning less. For real income changes, the dividing line between beneficiaries and contributors rises to $8,000. This shift occurs because the relative product price changes (the relatively lower prices for noncorporate output) favor the poor over the rich and also because the slightly lower, average price level enhances every group's real income.

In two cases, there is a positive fiscal burden inflicted on foreigners. This gain to Canada results from a slight appreciation in the exchange rate, coupled with a lower, after-tax payment to foreign capitalists. In each instance, the fiscal burden borne by foreigners is attributable, in part, to an improvement in Canada's world terms of trade. For the other cases, foreigners are made somewhat better off than before. The foreign fiscal burden or benefit represents between twenty and thirty-six per cent of the tax revenue raised.

If benefits to donors are taken into account, the degree of redistribution is not nearly as marked. On the evidence available, it was suggested in the previous chapter that donors enjoyed benefits roughly in the same proportion as their income. If the benefits are worth the amount that is actually distributed to the groups perceived to be poor, then perhaps 55-60 per cent of the tax revenues, the fraction of all transfers paid to those having less than $6,000 in annual income, generate benefits to donors. For a 10 per cent higher corporate income tax rate, about $263 mn. in extra revenue is created. Donor benefits would then be valued at between $145 and $158 mn. Allocating this amount, say $150 mn., according to initial factor income above $6,000, the change in real incomes would be revised in the following manner. The top income group would have its real income boosted by $43.2 mn., leaving it with a small, but still negative, fiscal residual. The next income group would receive almost the same amount, $42.7 mn., and end up with a positive fiscal residual. Similarly, the remaining income groups above $6,000 in annual income are beneficiaries in the amounts of $34.3 mn., and $32.3 mn., respectively. All of these households, therefore, are net gainers from the fiscal activity examined in this experiment. However, these conclusions are extremely tentative since the pattern of benefits used here requires much more rigorous testing before it can be generally acceptable.

Experiment (5): A 10 per cent increase in the federal personal income tax to finance an increase in transfer payments to the poor.

This experiment parallels the previous one except that the individual income tax, rather than the corporate income tax, is used as the source of an expanded program of transfer payments. We assume the same degree of slippage as before and allocate transfers, as well as personal income taxes, according to Table 3-7 in Chapter 3. Because the personal income tax is assumed to be neutral, this situation represents a pure case of expenditure incidence. The induced reduction in spending by the upper income groups, offset by the higher expenditures of lower income groups, results in the factor price changes shown in Table 5-6. Because the poor consume commodities which are relatively capital and land intensive, there is a tendency for the net return to capital and price of land, used in housing and agriculture, to rise. This induced reaction in relative prices opposes the initial redistribution by augmenting the return to factors owned predominantly by the rich and the prices paid by the poor for the consumer items that are most important to them. However, the countervailing price effects are of modest size and serve to dampen only modestly the impact of the initial redistribution of incomes. For any income group, this induced income change never exceeds $8 mn. in real terms and is usually smaller than $4 mn.

Referring to Table 5-6, it is seen that $7,000 in annual income marks the boundary between beneficiaries from the contributors to this tax-transfer scheme. This boundary is the same for both real and nominal income changes. All income groups together experience a real income deterioration of between approximately $31 mn. and $47 mn. A fraction of this loss can be explained by the fiscal benefits bestowed on foreigners. The remainder is attributable to induced government revenue increases and excess burden effects. The price of flexibly priced exports is raised but not by as much as the price of imports and fixed-price exports. This worsening in the world terms of trade, combined with a marginally higher return to foreign capitalists, is responsible for the negative, foreign fiscal burden.

Table 5-6

Experiment (5): A 10 per cent increase in the federal personal income tax to finance an increase in transfer payments to the poor.

5-6 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income (1)	(2)	(3)	(4)	Percentage Change in Real Income (1)	(2)	(3)	(4)
0- 2,999	7.7	7.7	7.7	7.7	7.5	7.5	7.4	7.5
3,000- 3,999	3.75	3.68	3.71	3.66	3.5	3.5	3.5	3.5
4,000- 4,999	2.15	2.09	2.11	2.06	1.94	1.94	1.94	1.92
5,000- 5,999	.95	.91	.92	.88	.75	.75	.74	.75
6,000- 6,999	.53	.48	.50	.48	.33	.34	.30	.33
7,000- 8,999	-.11	-.15	-.13	-.19	-.31	-.29	-.36	-.31
9,000-10,999	-.73	-.78	-.76	-.80	-.92	-.97	-.96	-.91
11,000-14,999	-1.13	-1.19	-1.17	-1.22	-1.32	-1.33	-1.34	-1.33
over 15,000	-2.05	-2.14	-2.11	-2.17	-2.25	-2.27	-2.28	-2.28
all classes	.14	.08	.1	.06	-.05	-.05	-.08	.06

5-6 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	.53	.37	.9	-	$-12.4
(2)	.28	.38	1.6	-	$-16.5
(3)	.32	.44	2.8	-	$-29.1
(4)	.16	.41	2.6	-	$-25.7

Note: (1) For a description of the parameter values in cases (1)-(4), see Table 5-2.

(2) Since the intent is to raise the existing incomes of the poor, disposable income of each income group is used as the base for calculating the percentage changes.

Proceeding as before, donor benefits may be worth about 55-60 per cent of the sum actually transferred ($872 mn.), or an amount on the order of $480 to $523 mn. If these benefits are enjoyed in proportion to initial factor income by those earning more than $6,000 annually, the highest income bracket receives $138 mn. in benefits, while the other brackets above $6,000 receive, in order following the top bracket, the amounts of $136 mn., $101 mn. and $103 mn. Adding these values to those shown in Table 5-6 for real income decrements, it can be concluded that all income groups, except the top one and possibly the one next to it, would be better off if this hypothetical, tax-transfer scheme were implemented.

Experiment (6): A one per cent increase in the federal personal income tax rate to finance a fare reduction for urban transit.

There are four aspects to this experiment: imposition of the income tax, use of the proceeds to subsidize transit fares, the induced adjustment of relative factor prices, and the generation of significant external benefits. Turning to the results shown in Table 5-7, it can be observed that this experiment elicits no alteration in the structure of relative factor and product prices. The reason behind this particular result is that the capital-labor ratio in the production of transit services is approximately equal to the median value for the whole economy. Thus, when the income tax curtails private expenditure, resources are released from private sectors having capital-labor ratios which, on average, are the same as the expanding transit sector. In effect, we have uncovered a "flat" section of the economy's production

Table 5-7

Experiment (6): A one per cent increase in the federal personal income tax rate to finance a fare reduction for urban transit.

5-7 a. Size Distribution (millions)

Income Class	Percentage Change in Nominal Income	Percentage Change in Real Income
0- 2,999	.25	.26
3,000- 3,999	.20	.22
4,000- 4,999	.14	.19
5,000- 5,999	.12	.19
6,000- 6,999	.03	.13
7,000- 8,999	.02	.14
9,000-10,999	-.03	.13
11,000-14,999	-.06	.03
over 15,000	-.17	.07
all classes	0	.14

5-7 b. Change in:

Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Foreign Fiscal Burden (millions)
Insignificant	Insignificant		None

Note: (1) Cases (1)-(4) are identical for this particular experiment.

(2) Disposable income is used to calculate the percentage changes shown in part (a) of this table.

possibilities locus. Based on our earlier discussion, "output" effects are absent in this case. As a result, government expenditures on urban transit have a neutral effect on the sources of income side of fiscal incidence when financing occurs through the personal income tax. Thus, changes in nominal income occur, in the first instance, only as a consequence of the adjustment in the income tax.

On the uses of income side, the subsidy to urban transit is enjoyed in proportion to the initial consumption of these services. The figures in the second column of Table 5-7a represent the subtraction of the income tax burden from the real income gain associated with the subsidy. The latter has been distributed across income groups according to the series presented earlier in Chapter 4 (Table 4-3) which indicates the degree to which transit services are used by different income groups. Ignoring any excess burden, there is a zero-sum redistribution of income among different income groups. Income groups earning less than $9,000 annually pay less income tax than the value of the lower transit price which they enjoy in consumption. Conversely, income groups above the $9,000 bracket are net contributors to the welfare of those earning less.

However, when external benefits are brought into the picture, all income groups become better off in absolute terms, as is evident from the third column of figures in Table 5-7a. In the previous chapter, the methodology for measuring the size of these benefits and allocating them to income classes was described in considerable detail. A precise determination of the size of these benefits requires some specific information about average speeds in urban areas and the average distance driven on urban trips. We adopt what we believe are reasonable values for these variables in the absence of reliable data on this topic.

Assuming an average speed of 15 m.p.h., the elasticity of average speed with respect to the number of automobiles is .67. If, in addition, the average distance travelled is 10 miles, it was estimated earlier that an increment in the transit subsidy of one dollar would generate external benefits worth ninety cents. In our example, a subsidy of \$87.2 mn. would entail external benefits valued at \$78.5 mn. Allocating these benefits in line with Table 4-3 produces the gain in real income implied by the difference in the values that are recorded in the second and third columns of Table 5-7. While all income groups increase their welfare, those earning less than \$6,000 in annual income reap a larger than average gain and, thus, experience a redistribution of income in their favor. Only the top two income groups receive a benefit that is noticeably less than the average.

Although the fiscal change envisioned by this experiment appears to promise what most people would judge to be an improved income distribution and, as well, the likelihood of a superior resource allocation, it does not necessarily follow that this policy should be immediately adopted. There may be alternative policies which could achieve the same distributive outcome but an even better, or more efficient, allocation of resources. In the concluding chapter, we briefly discuss other possible means of controlling urban congestion and the failure to price scarce road space. It is suggested there that a more direct approach, one of taxing the source of the congestion, that is, automobile use, may offer a more attractive solution than subsidizing the consumption of non-congesting alternatives.

Experiment (7): A 3.3 per cent increase in the federal corporate income tax to finance subsidies for urban transit.

Unlike in the last experiment, the source of finance for the urban transit subsidy noticeably affects the distributive outcome in this case. To achieve direct comparability with the previous experiment, the corporate income tax has been raised by an amount just sufficient to finance the same expansion in urban transit services as in the previous experiment. The incidence of this particular tax and expenditure change is virtually identical to that which occurred when the corporate income tax was used to finance a proportional increase in local government expenditures. Rather than present all four cases, we have chosen the third case to be representative of them all since the differences between the various cases are barely perceptible and do not merit further repetition.

This particular selection of cases gives rise to the second column of results in Table 5-8 showing the changes in nominal income. The second and third rows, depicting the distribution of real income gains resulting from, first, the fare subsidy and then both the subsidy and the external benefits, embody the same assumptions made earlier and merely repeat the values used in the foregoing sixth experiment. Although the corporate income tax is a progressive source of finance, it is not as powerful a force for progressivity as the individual income tax.[12] From an examination of the last column of Table 5-8, it seems that the corporate tax progressivity and the pro-poor distribution of the subsidy benefits are by and large offset by the pro-rich stream of external benefits. Removing or reducing congestion is similar to repealing a tax that is voluntarily paid mainly by upper income groups. To be sure, there is still some redistribution that occurs between the very top and the very bottom but, in between these extremes, there is no significant redistribution of real incomes. At this point, however, it should be kept in mind that this conclusion, like many of the earlier findings, is conditional upon how firm our knowledge of benefit incidence can be considered to be. As we hope our discussion here and elsewhere demonstrates, there is still a great deal of work to be done in this largely unexplored area of fiscal incidence.

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[12] One implication of this finding is that integration of the corporate and the personal income tax might enhance the progressivity of the tax system.

The rather large lacunae in the present understanding of precisely who benefits from government spending are a source of embarrassment only in the context of balanced-budget fiscal experiments. These pitfalls in the incidence exercise can be avoided if attention is restricted to a differential incidence setting. To some extent, this narrower focus of differential incidence is a mere ducking of the benefit issue, which avoids a confrontation with ignorance. On the other hand, it tailors the scope of the investigation more closely to what can feasibly be delivered or promised by the current research framework. We shall turn to two experiments that are of a differential incidence nature after we have conducted two more balanced budget exercises, one that tries to stimulate housing from the demand side and another that works from the supply side.

Table 5-8

Experiment (7): A one per cent increase in the federal personal income tax rate to finance subsidies for urban transit.

5-8 Size Distribution
(millions)

Income Class	Percentage Change in Nominal Income	Percentage Change in Real Income	Percentage Change in Real Income Including External Benefits
0- 2,999	-.07	.20	.21
3,000- 3,999	-.17	.08	.10
4,000- 4,999	-.16	.05	.09
5,000- 5,999	-.14	.06	.14
6,000- 6,999	-.13	.02	.12
7,000- 8,999	-.13	.02	.14
9,000-10,999	-.15	.02	.13
11,000-14,999	-.16	.03	.15
over 15,000	-.22	.11	.13
all classes	-.55	.0	.14

Notes: (1) Cases (1)-(4) yield virtually the same results in this experiment.

(2) Disposable income is used to calculate the percentage changes in real and nominal incomes.

Experiment (8): An increase in the federal personal income tax with the proceeds used to subsidize the purchase price of housing services.

If the purchases of housing services are subsidized, and the personal income tax is the source of funds for the subsidy, there is a marked redirection of expenditure patterns towards a capital and land intensive sector at the expense of the other sectors in the economy.[13] It is not puzzling, then, to discover that the relative prices of capital and, in particular, land increase in response to this expenditure switch.

Since the income tax bites into the purchasing power of the upper income brackets with considerable vigor, corporate output, which is favored by rich consumers, bears a large part of the brunt of the contraction of nonhousing sectors of the economy. Land is redeployed from domestic agriculture (where final demand falls) to housing (where final demand has increased) and to fixed price exports (where final demand is unchanged). As the economy's exchange rate depreciates exports of both kinds increase moving factors into the foreign production sectors. The higher the foreign demand elasticity, the easier it is to absorb additional factors in the export sector. The small increment in the gross price of corporate capital imparts a modest incentive for capital to enter Canada. The more readily foreign capital enters, the smaller is the increase in capital's net return, since a greater supply of capital is available to meet an increased demand for capital use. Another facet of this increase in total capital is the displacement of more domestically owned capital to those noncorporate sectors, that is, fixed-price exports and housing, where demand has not fallen.

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[13] In this experiment, the indirect tax on housing was cut by 50 per cent and the income tax needed to make up for this revenue loss (about a 2 per cent increase) was found iteratively. This is equivalent to a subsidy in the form of rental or mortgage interest assistance. It does not matter in our model whether the subsidy applies to new or old housing, or both, since the services provided by houses of any vintage are assumed to be perfect substitutes for those of another vintage. In practice, it has been frequently noted that assisted home-ownership programs reduce the demand for, and the price of, existing older homes.

The repercussions of these resource and price adjustments on the size distribution of income can be seen in Table 5-9. On the sources side of incidence, the higher prices for the nonlabor factors oppose the progressive nature of the income tax. Still, there is a progressive redistribution of nominal income. Interpreting the changes in real income is a little more difficult. All income groups realize higher, real incomes, primarily because of induced changes in the level of government revenues. The greater weight of housing services in the economy results in a loss of both indirect and capital tax revenue, with the effect of increasing real after-tax incomes in the private sector. Therefore, to gauge the degree and extent of redistribution, it is necessary to compare each group's percentage income change with that realized by all classes. Doing that, it appears that there is a significant redistribution of incomes from those earning above $9,000 annually to those earning less than that amount. On the uses side of incidence, the reduction in housing prices is especially favorable to the poor.

There is also a minor redistribution of income from Canadians to foreigners. While the small depreciation in the exchange rate worsens

Table 5-9

Experiment (8): An increase in the federal personal income tax to subsidize the price of housing services.

5-9 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	.27	.32	.40	.37	2.26	2.35	2.18	2.36
3,000- 3,999	.28	.32	.39	.37	.74	.83	.80	.83
4,000- 4,999	.14	.18	.22	.20	.50	.53	.80	.83
5,000- 5,999	.02	.05	.08	.07	.34	.30	.36	.39
6,000- 6,999	-.02	.00	.03	.03	.27	.23	.28	.32
7,000- 8,999	-.06	-.04	-.01	-.02	.21	.20	.23	.26
9,000-10,999	-.08	-.05	-.02	-.03	.16	.18	.18	.21
11,000-14,999	-.11	-.09	-.05	-.07	.06	.09	.08	.11
over 15,000	-.17	-.14	-.10	-.12	-.03	-.02	.00	-.02
all classes					.19	.22	.21	.24

5-9 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	.67	4.1	.34	-	$ -9.24
(2)	.36	4.2	1.26	-	$-14.3
(3)	.40	4.3	2.73	-	$-29.7
(4)	.19	4.2	2.5	-	$-25.4

Note: (1) For a description of the parameter values in cases (1)-(4), see Table 5-2.

(2) Initial factor income, before transfers and personal income taxes are applied, is used to calculate the percentage changes in real and nominal incomes.

the terms of trade for Canada, the higher net return to capital transfers more real income to foreign capitalists. The amounts involved, however, are extremely small.

Although some people have alleged that housing consumption confers positive externalities on others in society--for example, it may generate donor benefits in the case of publicly assisted housing or, by giving someone more of a stake in the system, it may make him a more responsible citizen--we are not aware of any attempt to measure the size of these benefits and are sufficiently dubious about the strength, and even existence, of these effects, that we shall not pursue this matter here.

Experiment (9): An increase in the federal personal income tax to finance a subsidy to the cost of land used in housing.

In contrast to the last experiment, the fiscal setting in this case applies a subsidy to the other side of the housing market, the supply rather than the demand side. Instead of trying to help consumers meet their housing expenses, the intent here is to subsidize the cost of housing inputs and indirectly reduce the price paid by consumers. In simulating the impact of such a cost subsidy, it was discovered that the cost of the subsidy was absorbed entirely in a higher price, or rental, for land used in the housing sector. Landowners capture all of the subsidy benefits and nothing else changes. Since this story has such a short and simple ending, no table appears for it. The redistributive impact is mildly progressive because the share of personal taxes for the upper income group is larger than its share of capital (land) income.

The reason for this outcome is easily understood: just as a tax on a relatively immobile factor is borne entirely by that factor, so is a subsidy on the use of the same factor also "borne" by it (but with the opposite sign to a tax). Despite the low value (.1) for the land mobility parameter which has been used to produce this result, the finding is reasonably robust. If the mobility parameter is alternatively raised to a value of .9 (near the upper limit to the range of values described in Chapter 3) the results are roughly the same. Instead of landowners snatching all of the subsidy, they are now able to appropriate only 91 per cent of it. Although other groups benefit, the main effect is still to enrich landowners. On the sources of income side, capitalists also benefit from the subsidy to a very small degree, while, on the uses of income side, there are virtually no significant benefits which accrue to purchasers of housing. We conclude that subsidies on the use of land in housing are an ineffective method of extending the consumption of housing. The benefits of this subsidy would be captured in the main by existing homeowners and would do little to aid prospective homeowners.

Experiment (10): Replacement of a portion of the nonresidential property tax with a higher corporate income tax.

In this experiment one tax on capital income is replaced by another tax on the earnings of capital. The proceeds from a 10 per cent hike in corporate income taxes are used to replace about 21 per cent of nonresidential property taxes. Since neither tax is perfectly general, however, there are significant compositional effects associated with this tax substitution. Noncorporate output, with the exception of housing, is favored at the expense of corporate output. By itself, this effect would increase the relative return to capital since non-corporate output is relatively capital intensive. As noted before, though, these output effects are "weak" if housing is not involved, and any tendency towards a higher capital price is outweighed by the substitution of capital for labor in the large corporate sector. On balance, there is a small decline in the net return to capital, a decrease which is consistent with the results of the first and second experiments. Both of these experiments generate approximately the same expansion in local government services. If the signs of the second experiment are reversed, it is easily seen that lowering the property tax will raise the net price of capital by less than a similar increase in the corporate income tax will reduce capital's net price.

There is, in addition, a marked shift in the composition of exports. In response to a heavier corporate tax burden, the flexibly priced export sector contracts. Simultaneously, fixed-price exports are stimulated by the decline in the property tax. As these agriculturally based exports, and, as well, domestic agriculture, expand, the price of land used in these sectors is bid up and some land is in the end transferred to the former sector from the latter. The greater the size of this change in the origin of export activity, the larger the values are for both the foreign demand export elasticity and capital supply elasticity. The more price elastic is foreign demand, the more the production of flexibly priced exports contracts. As the supply of foreign capital becomes more elastic, the greater is both the displacement of Canadian-owned capital from the corporate sector and the expansion of the noncorporate sector, which serves to diminish the price of capital (more capital is employed in the noncorporate sectors only at a lower net return) and augment the price of land (a factor in relatively inelastic supply). As is evident from Table 5-10, the decline in the return paid to capitalists is almost exactly offset by the higher price paid to landowners. Relative to labor income, capital incomes remain intact when the hypothesized tax substitution occurs. As a result, there is an inconsequential change in the size distribution of both nominal and real incomes. For all intents, there is no redistribution of income either between capital and labor or among income groups in this differential incidence exercise. Only the very bottom income group fares somewhat better than other groups, in this instance, due to their relatively high consumption of cheaper food commodities.

A different conclusion, however, is reached for the international incidence of this experiment. Canada enhances its welfare at the expense of foreigners under the given tax substitution. Raising the corporate income tax serves to curtail the production of corporate-dominated, flexibly priced exports (e.g., newsprint) in which Canada has some monopoly power. Total exports also decline, despite the expansion of mainly noncorporate, fixed-price exports, causing a small appreciation in the exchange rate and better terms of trade for Canada. Reinforcing both of these real income gains is a reduction in the payments made to owners of foreign capital. The real income benefits to Canada vary within a range of about \$70 to \$100 mn.[14]

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[14] While this income change is insignificant as a fraction of GNP, it represents between 27 and 39 per cent of the total tax revenues that are collected and can hardly be called insignificant from this perspective.

Table 5-10

Experiment (10): Replacement of a portion of the non-residential property tax with a higher corporate income tax.

5-10 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	-.19	-.27	-.24	-.32	.42	.55	.48	.39
3,000- 3,999	-.17	-.25	-.22	-.30	.04	.04	-.05	-.04
4,000- 4,999	-.14	-.20	-.17	-.23	.03	.03	-.05	-.03
5,000- 5,999	-.10	-.15	-.12	-.17	.04	.04	-.02	-.06
6,000- 6,999	-.09	-.14	-.11	-.16	.05	.06	-.02	-.02
7,000- 8,999	-.08	-.12	-.10	-.14	.05	.06	-.01	-.02
9,000-10,999	-.09	-.13	-.12	-.16	.01	.03	-.01	-.01
11,000-14,999	-.09	-.13	-.12	-.16	.02	.03	-.02	-.01
over 15,000	-.11	-.17	-.15	-.20	-.00	-.01	-.05	-.05
all classes	-.10	-.15	-.13	-.17	.03	.03	-.02	-.00

5-10 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	-.47	2.0	2.4	-	$99.5
(2)	-.72	3.0	3.1	-	$94.1
(3)	-.65	1.6	5.6	-	$71.4
(4)	-.83	1.3	5.4	-	$75.0

Note: (1) For a description of the parameter values in cases (1)-(4), see Table 5-2.

(2) Initial factor income, before transfers and personal income taxes, is used to calculate percentage income changes.

Experiment (11): Replacement of a portion of the residential property tax with revenues from the federal personal income tax.

In the last of our series of hypothetical scenes, a 2 per cent increase in the personal income tax is used to finance a reduction in the residential property tax of about 7.5 per cent. The initial impact of this tax substitution is felt as a decline in the cost of housing capital, which reduces the cost of housing services and elicits an increase in the quantity demanded of these services. At the same time, producers of these services seek to substitute the now cheaper capital for other factors, which further adds to the demand for capital in this sector. The income tax releases resources from other sectors, especially the corporate sector, whose output decline reflects the reduced demands of the rich that are particularly burdened by the income tax. Expansion of the relatively capital intensive housing sector exerts a small degree of upward pressure on the net return to capital.

The most striking effect of the tax substitution is the induced increase in the price of land used in housing. Since the income share of land in housing is about .25, one might predict that a 7.5 per cent reduction in the residential property tax would raise the price of land by 1.875 per cent (one-quarter of 7.5 per cent) since this factor is relatively immobile. However, the increase in land rents is almost twice this amount, which indicates that some portion of the tax on capital in housing is borne by land (and, conversely, that a reduction in the property tax on structures will benefit owners of land). The low elasticity of factor substitution between land and other factors also contributes to this result since it makes the demand for land relatively inelastic with respect to changes in its price.

Table 5-11

Experiment (11): Replacement of a portion of the residential property tax with higher revenues from the federal personal income tax.

5-11 a. Size Distribution (millions)

Income Class (dollars)	Percentage Change in Nominal Income				Percentage Change in Real Income			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0- 2,999	-.11	.00	.01	.01	1.6	1.5	1.5	1.5
3,000- 3,999	-.01	.00	.04	.03	.42	.43	.42	.42
4,000- 4,999	-.06	-.05	-.04	-.04	.21	.24	.24	.26
5,000- 5,999	-.13	-.13	-.11	-.11	.12	.17	.14	.16
6,000- 6,999	-.16	-.15	-.15	-.15	.07	.09	.09	.10
7,000- 8,999	-.19	-.20	-.18	-.18	.02	.05	.05	.06
9,000-10,999	-.21	-.21	-.20	-.20	-.03	-.00	-.00	.00
11,000-14,999	-.25	-.25	-.24	-.24	-.10	-.08	-.08	-.07
over 15,000	-.35	-.35	-.33	-.34	-.24	-.21	-.20	-.20
all classes	-.22	-.22	-.21	-.21	-.02	.00	.00	.01

5-11 b. Change in:

Case	Return to Capital (%)	Return to Land in Housing (%)	Return to Land in Agriculture (%)	Government Revenue (millions)	Foreign Fiscal Burden (millions)
(1)	.17	3.1	-.53	-	
(2)	.09	3.1	-.30	-	
(3)	.10	3.1	.08	-	insignificant
(4)	.05	3.1	.02	-	

Note: (1) For a description of the parameter values in cases (1)-(4), see Table 5-2.

(2) Initial factor income, before taxes and personal income taxes, is used to calculate the percentage income changes.

As is shown in Table 5-11, this fiscal experiment leads to an unambiguously progressive redistribution of income. If real income changes are examined, income groups earning more than $9,000 in annual income experience reductions in real income that contribute to the enhanced welfare of those earning less. On the sources of income side, the induced rise in the prices of land and capital work against a progressive outcome but the effect is quantitatively small. Lower income groups become better off because they largely escape the burden of the income tax and because they particularly benefit from a lower price for housing services. Finally, since the factor price changes outside the housing sector are barely perceptible, the terms of trade with the rest of the world are stable. Consequently, the change in the foreign fiscal burden is of insignificant dimension.

It would not be easy, and probably not worthwhile, to attempt to summarize this extremely diverse set of fiscal experiments beyond what has been said already at the beginning of this chapter. With few exceptions, we are impressed by the rather modest success of these experiments in achieving a significant redistribution of income. The merits of implementing the experiments may very well turn on their efficiency aspects, a topic we discuss in the final chapter. First, however, we consider the results for the provincial revenue-sharing experiments.

Chapter 6

Provincial Revenue-Sharing Experiments

Part I: Limitations of the Regional Model

In the last chapter we were concerned with the national and, to a much lesser extent, regional incidence of national fiscal policy changes. In this chapter our attention shifts to the national and provincial incidence of provincial tax and expenditure changes. Unfortunately, limitations stemming from both the aggregative nature of our model and the availability of data constrain our ability to provide satisfactory answers to many of the issues which are of interest at the provincial level. For reasons which soon will be apparent, we have more confidence in the results of those experiments where only income or sales taxes are changed than in those that involve corporate income or property tax changes.

Because of data limitations, we are unable to divide our output categories into less aggregative outputs which differ in their characteristics for different provinces. That is, we must still deal with a single category of domestically consumed corporate output, C, and we must assume that the C output produced in British Columbia is identical to that produced in Ontario. The same holds for E and F. Further, we are unable to distinguish either inputs which are unique to a specific region or technologies which are found only in one region. Therefore, the production functions are the same in all provinces and a unit of capital or labor in one province is identical to a unit in some other province.[1]

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[1] This does not mean that it is currently impossible to gather significant evidence on the output of a single province and on how that output differs from that of other provinces. Further, one could gain some information on provincial differences in factor usage and production techniques. But it is well beyond the scope of this study to supply such data, particularly to generate a data set sufficiently complete that it could be used in a model such as ours which stresses the interdependence of markets.

We do not wish to imply that, because of these limitations, an analysis of provincial tax changes that uses our model is pointless. A substantial portion of any province's output is likely to be similar to the output of at least some of the other provinces. Even if there are no substitute products initially, close substitutes may be developed eventually. Further, in the long-run, technological differences between provinces would disappear, though some inputs, such as natural resources, may well remain unique to a certain region. Thus, while the results obtained from a model such as ours will not give as complete a picture of the effects of fiscal policy changes as our national model (which itself is rudimentary), the model can still provide some insight into the impact, in particular the long-run impact, of a single province attempting to alter its tax system so that it differs markedly from the tax system found in other provinces.

Having highlighted the crucial and unrealistic assumptions that we have imposed, we now turn to an explanation of how these assumptions affect our results. If the output of C, E, and F is identical across regions within Canada, then producers' price (ignoring transport costs) and the change in producers' prices for these products must be the same in all provinces. Since the change in producers' prices is simply the change in factor costs weighted by factor shares, the following two price equations, if $P_N^r = 1$, must hold for any province:

$$\theta_{KC} \hat{P}_k^r = \theta_{KC} (\hat{P}_k^P + \widehat{(1 + t_{KC})}) + \theta_{NC} \hat{P}_N^P$$

and

$$\theta_{KE} \hat{P}_k^r = \theta_{KE} (\hat{P}_k^P + \widehat{(1 + t_{KE})}) + \theta_{NE} \hat{P}_N^P$$

where P_k^P is the net rate of return to capital in the province in question and P_k^r is the net rate of return in the rest of Canada. The expressions $(\widehat{1 + t_{kc}})$ and $(\widehat{1 + t_{ke}})$ are the changes in capital tax rates (corporate income or property) occurring in the province (we are examining a case in which only provincial taxes change). Substituting from the first equation into the second, we obtain:

$$\hat{P}_N^P = \frac{(\widehat{1 + t_{KC}}) - (\widehat{1 + t_{KE}})}{(\theta_{NE}/\theta_{KE} - \theta_{NC}/\theta_{KC})}$$

Since initial factor shares are taken to be the same in all provinces, this equation implies that the effect of a given provincial tax change on provincial wages must be the same for any province. Furthermore, the change in the wage rate is independent of all demand and factor mobility elasticities. Inserting the equation for $\hat{P}_N^P$ into either of the first two equations shows that the change in the provincial rate of return to capital relative to the national rate of return, $(\hat{P}^r{}_k - \hat{P}^P{}_k)$, must also be the same for all provinces and likewise be independent of all demand and mobility elasticities.

A numerical example may help to illuminate the implications of this result. From Table 3-2, we calculate that $\theta_{NE}/\theta_{KE} = 1.74$ and that $\theta_{NC}/\theta_{KC} = 2.25$. For a 10 per cent increase in corporate taxes, $(\widehat{1 + t_{KE}}) = .027$ and $(\widehat{1 + t_{KC}}) = .025$. Thus, $\hat{P}_N^P = +.004$ and $\hat{P}^r{}_k - \hat{P}^P{}_k = .034$. Further, even in large provinces, provincial tax changes cannot be expected to be able to change national prices and rates of return by very much. Thus, we can expect $\hat{P}_k^r$ to be small in absolute value and $\hat{P}_k^P$, then, must be close to -.034. Without any reference to our complete model or to which province might be changing its taxes, we have determined that that complete model will show the provincial wage to have risen by .4 per cent and the provincial rate of return to capital to have fallen by about 3.4 per cent.[2]

This is a very strong result which stems from our restrictive assumption that outputs (though not the level of outputs) are identical in all provinces. If part of a region's output is an imperfect substitute for the output of other regions, its price may rise relative to other prices if provincial taxes change. If this were true, the entire set of demand and supply relationships in our model would be needed to determine the changes in factor returns.

One other numerical example, dealing with income or sales tax changes, will also be instructive. For an income or sales tax change $(1 + \hat{t}_{KC}) = (1 + \hat{t}_{KE}) = 0$. Therefore, $\hat{P}_N^P = 0$ and $\hat{P}_k^r = \hat{P}_k^P$. There is an impact on factor rewards only to the extent to which provincial policy changes can induce nationwide effects. As argued above, it is likely that such effects will be small and, accordingly, $\hat{P}_k^P$ will be small.

Part II: The Data

Before presenting more complete numerical results of a number of fiscal policy changes, it will be useful briefly to summarize our derivation of the data for the different provinces. A more detailed discussion of this matter is given in Appendix D. We obtained consumption expenditures in each area from the Family Expenditure Survey and then made some rather crude assumptions about the production location from which this spending was satisfied. This partitioning of the sources of supply between the region and the rest of the world was done in such a way that the balance of payments constraint applicable to each region was not violated. Domestic production of investment goods was allocated across the provinces on the assumption that this spending was satisfied entirely from local sources of supply. Expenditures on final output were then partitioned into net-of-tax factor payments and taxes using the national figures for those items. Finally, the government sector was divided into federal and non-federal components.

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[2] Using an equation which states that the change in the provincial and national price of F must be the same, analysis similar to that in the text can be used to calculate the change in the provincial rate of return to land used in the production of F.

Since regional differences in the cost of living are important factors for determining a worker's choice of residential location, we made an effort to include changes in real wages as the arguments in our labor mobility equations. For the experiments not involving sales tax changes, this meant introducing the weighted price changes of the nontradeable goods, A and H, into the mobility equation, with the weights being the expenditure coefficients of each income class which, in turn, were weighted by the distributive series on labor income in each province. The result is a price change weighted by an average expenditure coefficient for labor. Government and urban transit services were not included in this index of the cost of living because of their relatively small size. The output of the corporate sector and imports were excluded since, by assumption, these goods and services have the same price in every region. However, for the sales tax experiments it was obviously necessary to include corporate output in the measurement of the change in the regional cost-of-living index since consumer, but not producers', prices were allowed to vary interregionally.

Our overall impression of this modification to the labor mobility equation is that it did not have much effect on the result. In every experiment there was a modest alteration in factor prices, which translated into even more modest product price changes and a yet smaller weighted price change. In short, this concession to a more realistic specification of interregional migration did not really seem to justify the effort that was entailed in making the modification.

In addition to regional variations in the cost of living, there are, in our experiments, regional differences in the tax treatment of labor incomes. For a given level of the wage rate and price level, workers will find themselves better off in the region with the lowest personal income tax rate.[3] Thus, the wage variable that we enter in our mobility equations is the change in the real wage, net of personal income tax payments, where these are taken to be the average income tax payment for the region.

To convert statutory sales tax changes into effective rate changes for each of our final commodities, it is necessary to know the percentage of value-added which is caught in the base of the retail sales tax for each commodity. By their very nature of being sold abroad, exports E and F enjoy a complete exemption, although some of the inputs used in their production may be taxable. Likewise, housing and urban transit services are also excluded. Being non-marketed for the most part, government services escape the tax as well. In most jurisdictions, purchases of food (A goods) are entitled to full exemption, with the exception of restaurant meals in most cases. Almost one-half of the category of corporate output consists of producers' goods which are largely untaxed. On the other hand, construction equipment and materials are frequently taxed, while some consumer items, such as drugs and children's clothing, are usually exempt. The fraction of taxable to total corporate output may, therefore, be in the neighborhood of .6, and a one percentage point hike in the sales tax rate would, *ceteris paribus*, effectively raise the price of corporate output by .006. For commercial services and imports we assume that a somewhat higher proportion of output, .75, is included in the base of the retail sales tax.

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[3] More realistically, it is the fiscal residual, the difference between benefits received and taxes paid, that counts in influencing locational decisions.

Part III: Effects of the Provincial Policy Changes on Factor Returns and Outputs

From the discussion in the first section of this chapter, it is clear that there is not much point in presenting results for the various policy changes for each of the provinces. Accordingly, we only present some initial results for British Columbia and Ontario. British Columbia is a net importer of C and M, while Ontario imports only M and exports C, E and F. Complete results for the change in income by income class are given for British Columbia only in Table 6-2. Before presenting those results, we first present the changes in the various rates of return and

Table 6-1

A Comparison of Factor Price Changes in British Columbia and Ontario

Percentage Change in the Return to:

Balanced Budget Experiments a 10 per cent increase in:		Provincial Capital			Capital in the Rest of Canada			Provincial Labor			Provincial Land in Housing			Provincial Land in Agriculture			Agricultural Land in the Rest of Canada		
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
(a) provincial corporate tax	B.C.	-2.9	-2.6	-2.9	.41	.78	.40	.39	.39	.39	2.0	3.7	3.9	15.2	18.1	19.1	.9	2.9	4.1
	Ont.	-2.5	-2.0	-2.6	.90	1.4	.84	.40	.40	.40	4.9	9.8	11.1	13.6	19.1	22.1	2.4	7.7	10.8
(b) provincial property tax	B.C.	- .3	-.29	-.21	-.27	-.26	-.18	.39	.39	.39	-4.5	-4.5	-4.7	6.3	6.3	5.4	-2.7	-2.7	-3.4
	Ont.	-1.05	-1.05	-.67	-1.05	-1.05	-.67	-.40	-.40	-.40	-7.5	-7.5	-8.9	-4.6	-4.6	-7.5	-13.1	-13.1	-16.1
(c) provincial income tax	B.C.	-.41	-.3	-.21	-.41	-.3	-.21	0	0	0	-7.3	-1.4	-6.8	-4.1	-5.4	-4.5	-3.2	-4.3	-3.5
	Ont.	-1.03	-1.0	-.52	-1.0	-1.0	-.52	0	0	0	-4.8	-4.8	-4.8	-9.1	-9.1	-9.7	-9.2	-9.2	-9.8
(d) provincial sales tax	B.C.	-.13	-.13	-.06	-.13	-.13	-.06	0	0	0	0.25	.25	.27	-1.8	-1.8	-1.9	-1.4	-1.4	-1.5
	Ont.	-.21	-.21	-.11	-.21	-.21	-.11	0	0	0	1.2	1.2	1.3	-3.3	-3.3	-3.5	-3.4	-3.4	-3.6
Differential Incidence Experiments																			
(e) lower residential property tax; higher personal income tax	B.C.	-.02	-.02	-.02	-.02	-.02	-.02	0	0	0	4.03	4.03	4.03	-.26	-.26	-.26	-.21	-.21	-.21
	Ont.	-.02	-.02	-.02	-.02	-.02	-.02	0	0	0	3.9	3.9	3.9	-.9	-.9	-.9	-.9	-.9	-.9
(f) lower property tax (general); higher retail sales tax	B.C.	.02	.02	.04	.01	.01	.02	.2	.2	.2	2.5	2.5	2.6	-4.9	-4.9	-4.6	-.08	-.09	-.17
	Ont.	.59	.59	.59	.59	.59	.59	.2	.2	.2	3.4	3.4	3.4	3.0	3.0	3.0	7.23	7.23	7.23

Note: The three cases above correspond to the following choice of parameter values:

	Elasticity of: national labor mobility	national capital mobility
case (1)	2	2
case (2)	2	5
case (3)	5	5

the provincial wage rate. This allows us further to elucidate the nature of our provincial model.

The results shown in Table 6-1 were obtained under three alternative assumptions about parameter values for the factory mobility equations. In the first case, the elasticities for the national mobility of both capital and labor were set at two, while the international capital elasticity was fixed at one. For the second case, the national mobility of capital was increased to a value of five; everything else stayed the same. In the final case, both national elasticities were raised to a value of five and that for foreign capital was augmented to a value of three.

Consider, first, the results of a 10 per cent increase in the corporation income tax. As already demonstrated, the wage rate rose by .4 per cent while the local rate of return to capital fell. Indeed, the fall is about 2.6 to 2.9 per cent for British Columbia and 2.0 to 2.6 per cent for Ontario.[4]

As discussed at the beginning of this chapter, one need not use the entire model to obtain these results. However, the output changes which resulted from the tax changes must be derived by using the whole model. These changes are particularly interesting, for they indicate a knife-edge kind of response to provincial tax changes. For example, the 10 per cent corporate tax increase causes the flexibly priced export sector E to disappear, while corporate sector output grows by 189 per cent in British Columbia.

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[4] Note that $(\hat{P}_k^r - \hat{P}_k^p) = .034$, as the discussion in the beginning of this chapter showed must be the case.

Before proceeding to the results for other tax changes, consider the reason for this instability. Since, ignoring transport costs, the local prices of C, E, and F must all be equal to the national prices, it might be thought that increasing the local costs of producing these goods would cause output of all of them to decline or even disappear. However, this cannot happen. The balance of payments condition for each province is, if the capital account is ignored:

$$P_M M + P_c C^d = P_F F + P_E E + P_c C^P$$

where C^d refers to local consumption of C and C^P refers to local production. Obviously, unless consumption of M and C fall markedly, outputs of F, E, and C^P cannot each decline. Since the prices P_M and P_c will not change much (they are determined at the national level), there is no reason to expect that that demand for M and C will fall and, thus, the output of at least one of the three local products must rise if any one of the others should fall.

Since the tax increase is much higher on E and C^P than on F, one might expect output of both of them to fall with a larger increase in F. If production of F required only capital and labor, this would be possible. Output of F, in such a case, could expand, using just the capital and labor expelled from C and E production. However, since F production requires land, land must be bid away from the A sector as the output of F increases. This causes the rate of return to land (i.e., the cost of land) to rise markedly (note the sharp rise in the rate of return to agricultural land in experiments (a) and (b) of Table 6-1). That rise in the cost of land limits the growth of F output and, as a result, the commodity with the second smallest tax increase, C, rises as output of E falls.

If the property tax, residential as well as nonresidential, is increased instead, the preceding pattern of resource realignment is reversed. In response to a 10 per cent tax increase, the corporate sector within the province declines by about 50 per cent while the flexibly priced export sector mushrooms by almost 62 per cent. This is because the property tax rate increase is higher in the former than in the latter sector (see Table 3-2). In the rest of Canada, corporate output is increased by about 4 per cent while output of flexibly priced exports is diminished by around 13 per cent. These output adjustments are accompanied by minute (less than one per cent) declines in the return to capital in both regions and in the price of labor in the taxing province. The price of provincial land also declines in housing but becomes higher in the agricultural sector.

If local government services are alternatively financed by heavier retail sales taxation, then, as our discussion at the beginning of this chapter indicated would be the case, there is virtually no change in the net returns to capital and labor in either region and only a modest reduction in the return to land. Another way of stating this result is to note that the higher rate of retail sales taxation has almost no discernible effect on the side of the sources of income. Most of its impact will be felt instead on the side of the uses of income (according to other descriptions, the tax is shifted forward). Just as relative factor rewards were insensitive to regional resource endowments (different values for factor mobility), they are now, in this case, also immune from the influence of shifts in the pattern of final demand.

Much more modest changes in provincial output composition are associated with the sales tax than with the capital tax experiments. This is because the provincial costs of production are not directly affected by sales taxes. Output of the more heavily taxed sectors, C and Z, declines while all other sectors undergo an expansion in output. Because the decline in the production of corporate output exceeds its fall in consumption, output of flexibly priced exports to the rest of the world increases in order to pay for larger imports of corporate output from the rest of Canada. The absence of any implausibly large shifts in local output for this case, causes us to have more confidence in these results than in those for the property or corporate tax changes.

The differential incidence of reducing the property tax and replacing the revenue loss with higher retail sales taxation is also shown in Table 6-1. It is possible to infer the outcome of this experiment by comparing the results of two balanced budget experiments: the increase in the sales tax to finance a greater volume of government services and the increase in the property tax for the same expenditure purpose. If negative signs were applied to the results of the latter experiment, a measure of the effect of a lower property tax would be obtained, and if these results were subsequently added to those obtained for the former experiment, the outcome would approximate that of the differential incidence experiment, since the induced revenue change would be close to zero. Using either approach, it seems that the upshot is no significant change in the net returns realized by labor and capital coupled with a drop in the value of agricultural land rents and an increase in those paid in the housing sector.

Part IV: Size Distribution Effects for British Columbia

Although we have expressed some fairly deep misgivings about the representativeness of our provincial results, particularly with respect to the size of the output changes, we feel that there is some merit in pursuing the matter further and translating the relative price changes into the effects on the size distribution in income. We do this for only a single province, British Columbia, because of the previously noted lack of diversity in provincial results. While it is true that the distribution of labor income and expenditure patterns by income class differ slightly by province (see Appendix D for details), the differences are simply too small to significantly alter the outcome. Hence, we are entitled to view British Columbia as a representative province.[5] The factor price changes that occur in the rest of Canada are typically so small that it is not worthwhile examining the spillover effects of provincial fiscal changes. That is, the most significant effects of a new provincial fiscal setting are felt within the province itself.

Tables 6-2 and 6-3 present the provincial incidence of three balanced budget experiments and two more of a differential incidence

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[5] The only difference between the results for British Columbia and a province such as Ontario lies in the magnitude of the impact on rates of return in the nation as a whole. Since the economy of Ontario is much larger than that of British Columbia, tax changes in Ontario can be expected to have a greater impact upon prices and rates of return in the whole economy than will change in British Columbia. Our results in Table 6-1 indicate, for example, that an income tax increase in British Columbia will lower the national and local rate of return to capital by about .3 per cent. A similar tax increase in Ontario, however, would lower the rate of return by about 1 per cent.

Table 6-2

Balanced Budget Experiments for British Columbia

	Experiment (1)		Experiment (2)		Experiment (3)	
Income Class	Change in Real Income (mns.)	Per Cent of Initial Income	Change in Real Income (mns.)	Per Cent of Initial Income	Change in Real Income (mns.)	Per Cent of Initial Income
0- 2,999	- 2.07	-2.27	- 4.14	-4.54	- 2.1	-.45
3,000- 3,000	- 2.14	-1.24	- 3.27	-1.90	- 1.33	-.46
4,000- 4,999	- 2.54	-1.06	- 3.70	-1.60	- 1.2	-.45
5,000- 5,999	- 2.39	- .82	- 4.40	-1.40	- 1.11	-.46
6,000- 6,999	- 3.40	- .90	- 4.94	-1.30	- 1.52	-.45
7,000- 8,999	- 9.99	-1.00	-13.91	-1.45	- 4.9	-.47
9,000-10,999	-10.23	-1.09	-14.49	-1.55	- 4.6	-.47
11,000-14,999	-12.5	- .99	-16.70	-1.32	- 6.1	-.50
over $15,000	-11.91	- .93	-16.24	-1.26	- 5.0	-.53
all classes	-55.68	- .98	-80.01	-1.42	-27.8	-.48

Note: (1) Experiments (1) and (2) examine a hypothetical ten per cent increase in the provincial corporate income and property (residential and nonresidential) taxes respectively. A one percentage point increase in the sales tax to finance a proportional increase in municipal government spending is considered in experiment (3). The figures show the reduction in real income due to the tax change since expenditure benefits have not been allocated here.

(2) Initial income above refers to receipts before transfers and before personal income taxes, for the first two experiments, and to disposable income for the last experiment.

Table 6-3

Differential Incidence Experiments for British Columbia

	Experiment (4)		Experiment (5)	
Income Class	Change in Real Income (mns.)	Per Cent of Initial Income	Change in Real Income (mns.)	Per Cent of Initial Income
0- 2,999	-1.37	-1.50	2.00	.42
3,000- 3,999	- .70	- .40	1.03	.36
4,000- 4,999	- .16	- .07	.85	.33
5,000- 5,999	- .09	- .03	.54	.22
6,000- 6,999	- .12	- .03	.82	.24
7,000- 8,999	-1.29	- .13	2.34	.23
9,000-10,999	- .96	- .11	2.03	.20
11,000-14,999	-1.94	- .16	.93	.08
over $15,000	-1.70	- .18	-1.35	-.14
all classes	-8.33	-.147	9.19	.16

Note: (1) Experiment (4) involves replacing a portion of the provincial property tax (residential and nonresidential) with revenues from a higher provincial sales tax. Experiment (5) refers to the substitution of a higher provincial personal income tax for a lower residential property tax.

(2) Initial income refers to disposable household income above.

nature. The format of these tables is the same as that used in the previous chapter. Since it was evident from Table 6-1 that the factor price changes were almost invariant to the assumption about factor mobility values, we present only the calculations for the first set of parameter values that were employed. Looking first at the results for the higher corporate income tax used to finance a proportional expansion in local government services, it appears that, apart from the bottom group, the incidence of this fiscal change is a more or less proportionate change in the economic circumstances of each income class. The effect of a lower net return to capital is effectively cancelled by a higher return to land. This compares to a much more progressive impact of a corporate tax increase levied at the national level. If the distribution of benefits were to rise more than proportionately with income, this experiment would have a pro-rich bias. At best, there is likely to be no significant change in the distribution of income.

To digress for a moment, there is an interesting issue which arises in the context of provincial incidence but which has no parallel at the national level. This is the question of exactly whose welfare we wish to measure and how we want to measure provincial income. Is interest focused on the welfare of only the original population of the province, or should consideration be given instead to the group of individuals residing in the province in the new equilibrium? The answer that is forthcoming will decide how interregional factor flows should be treated. Consider total provincial labor income, for example, which may be written algebraically as $P_N^P\ L_p$. The change in this income variable is $L_p\ dP_N^P + P_N^P\ dL_p$ to a first-order approximation. At the national level, the second term in this expression vanishes, given a fixed supply of labor or, in the case of capital income, is treated as income accruing to foreigners. At the provincial level, there is neither a fixed supply of labor nor a fixed amount of capital. How then, should terms such as $P_K^P\, dK_P$ and $P_N^P\, dL_P$ be viewed, as "foreign" income or as fresh additions to provincial income received by either new workers or by capitalists who may reside elsewhere? The calculations shown in Tables 6-2 and 6-3 include the income changes attributable to factor flows; so, for example, if labor leaves (enters) the province, the migrant's earnings are subtracted from (added to) total provincial income. That is, we take the population resident in the province at the end of the adjustment period as the relevant group for welfare purposes but this choice is to some extent a matter of taste.

Continuing with the main story, it can be seen from Table 6-2 that an increase in the residential and nonresidential property tax, with the proceeds spent on local government services, also has an approximately proportional impact of the size distribution of income. Referring to the sources side of incidence, this is because there is almost no change in the ratio of net labor to nonlabor factor prices. When the uses of income side is included, however, an incidence profile with a slight inverse-U pattern emerges, reflecting the higher price of housing services and the tendency of low income groups to purchase a larger than average amount of them.

The last balanced budget experiment in Table 6-2 is one in which the proceeds from a higher retail sales tax are used to underwrite an expansion in local government services. As noted earlier, the redistribution that occurs in this case is felt almost exclusively on the side of the uses of income since relative factor prices are fairly insensitive to a higher sales tax. Appendix D develops the expenditure estimates by income class that are needed to make this determination on the uses side. Applying these data to the tax-induced rise in commodity prices generates the incidence pattern shown in Table 6-2. Because the tax strikes the output of the corporate sector, consumed more heavily by the rich than by the poor, and exempts food and housing which are consumed more heavily by the poor, the increase in the sales tax tends to fall with greater weight on the upper income groups. Since what matters here is the change in the purchasing power of nominal income from all sources (including transfer payments), it can be argued that disposable income is the appropriate base for comparison among income groups rather than pre-tax and transfer factor income. The percentage changes shown in Table 6-2 use, in this case only, the alternative basis of comparison. On this basis, income groups receiving less than $9,000 in annual income have a less than average burden imposed upon them, while groups receiving more than $9,000 bear a relatively larger than average burden. In the usual jargon, the sales tax is somewhat progressive; it is borne more by those earning more than $9,000 annually than by those earning less. However, as was true in the previous experiments, if the expenditure benefits are proportional to income, or nearly so, there is an insignificant redistribution of income.

Table 6-3 describes the results of the two differential incidence experiments. When the residential property tax is replaced, in part, by a higher personal income tax (experiment 5), the effect is that of one progressive tax substituting for another. Closer inspection of the incidence profile reveals that it has a very slight tendency towards progressivity. At the bottom of the income scale, the higher incomes received from land ownership more than offset the extra personal income tax payments. Gradually, however, the progressivity of the personal income tax begins to dominate and the very highest income groups are net losers from the tax substitution.

Also shown in Table 6-3 is experiment (4), where the proceeds from a higher sales tax are used to replace the revenue lost from a reduction in both residential and nonresidential property taxes. The pattern of income changes that emerges from this tax substitution is a U-shaped incidence profile. Bottom income groups do not share nearly as much in the expansion of nominal incomes, when the relative price of labor increases, because of their low share of labor income. At the same time, however, the exclusion of housing services and the exemption of food from the base of the retail sales tax is of special benefit to them since they purchase a larger than average amount of these particular items. High income groups, who consume a disproportionate amount of corporate output, are burdened relatively heavily by the tax induced change in relative product prices. However, the extent of the redistribution from the top and bottom income groups to those in the middle is extremely modest.

It is time to pause briefly and inquire about the degree of confidence that can be placed in our simulations. Are the results by and large a fiction of the model, more reflective of its rigidities than of the real world, or do they adequately capture some important aspects of the adjustment process to fiscal changes? Our own feelings on this matter are somewhat mixed. We believe that in most cases the direction of the indicated changes in size distribution are not implausible in view of what earlier work has produced on the subject. They are also consistent with the national changes analyzed earlier. Compared to the federal revenue-sharing results, those achieved for provincial revenue-sharing, more often than not, show a proportional rather than progressive impact on the distribution of income. Previous research has also suggested that federally initiated fiscal changes may have a more progressive character than those carried out at the provincial level. However, we are unhappy about treating a province, in fact every province, as a scaled-down, miniature version of the nation. This is essentially a data problem. The basic problem with the model, its failure to admit regionally heterogeneous factors and outputs, is also in the nature of a data difficulty since it is, in principle, easy enough to extend the model in the direction of adding a richer variety of factors and products. We discuss these possibilities in the final section of the chapter.

Despite some obvious shortcomings, the model does tell us two things about the real world that are of some policy interest. First, to the extent that competing firms in two areas are identical, that is, they have the same production function and produce the same product--they must, from the perspective of a single province, be taxed in the same manner as they are in other parts of the country. Otherwise, significant distortions in the location of production will occur. Federal states require provincial tax harmonization and its associated surrender of some fiscal sovereignty. There are any number of ways that this goal might be achieved. For corporate taxes, federal preemption of this tax field would do it automatically. Less drastic measures call for interprovincial consultation, agreement and coordination. Any arrangement that emerged should probably be carried over to apply to property taxation, although the admission of yet another level of government to the bargaining table certainly complicates the picture. At least in the case of corporate taxes (less is known about the interprovincial variation in property taxes), provinces appear tacitly to recognize their fiscal interdependence since the observed variation in provincial rates has been quite low, lower in fact than the tax changes we have introduced in our experiments.

Secondly, and equally important, our model helps to expose some of the different reactions to fiscal changes that occur in an open, in contrast to a closed, economy. As we saw at the beginning of this chapter, if a region produces more products than there are identifiable factors, that region's external terms of trade, the prices established in the rest of the world, will largely determine the factor prices that can prevail in that region in the face of external competition. These factor prices will help to establish the costs of producing nontraded goods (in fact, they will completely determine them if traded and nontraded goods employ the same inputs). This linkage between external product prices and internal factor prices has the following significant implication: relative factor prices are largely unhinged from their dependence on internal demand conditions (the composition of demand within the region) and on the resource endowment of the region. This is why, for example, sales taxes exert no measurable impact on the level of factor prices and why factor prices do not respond to the varying degrees of interprovincial factor mobility (changing regional resource endowments). A corollary implication holds for the behavior of output: if relative product prices cannot adjust to new fiscal settings within a region, then quantities (production levels and factor flows) must do all of the work instead, in order to restore an equilibrium that has been disturbed by fiscal change. The instability in our model, that was noted earlier, is merely a reflection of this facet of the adjustment capacities that are built into the model.

Part V: Where Do We Go From Here?

If we have had only limited success in modelling the global reactions to the provincial revenue-sharing experiments, it behooves us to consider other approaches to the problem which may hold out the promise of greater success than we have been able to achieve. We emphasize that we do not feel our own efforts in this direction constitute a complete failure. We have not achieved as many results as we would have liked, and those that were realized we feel need to be checked against alternative, and, we hope, more realistic, models. Yet, we did learn a great deal about what is currently feasible.

We are of the opinion that, in order to determine the accuracy of our results, one will need to incorporate the existence of regionally specific products and regionally unique factors. The importance of identifying these types of goods and factor services can be appreciated by considering two quite different local provincial scenarios. If there is no mobility of products (all products are home or non-tradeable goods such as housing services) and there is a reasonable degree of factor mobility, then factor taxes will have a large impact on product prices and a smaller effect on factor prices with the tax being borne by consumers and the relatively immobile factors, land and labor.[6] On the other hand, if a large fraction of regional output is devoted to interregional or international trade, over which the region has little price control and regional resources are imperfectly mobile, the impact of factor taxes will show up more in the form of lower factor prices and less in the guise of higher product prices. Again, relatively immobile regional factors will bear the tax.[7] However, if both products and resources tend to be highly mobile, as is true for our model, large output adjustments occur which are simply not observed in the real world unless one is willing to believe that the process of adjustment is extremely slow.

What kinds of modifications to the model seem to be called for? At a minimum, it would be desirable, if the data permitted, to admit land into the production function for corporate output and possibly other sectors too. A more ambitous leap would be to identify various categories of natural resources as an especially productive form of land input. These inputs would be especially important in the production of flexibly priced, corporate-dominated, exports. If this were done, we suspect that these inputs would bear the bulk of the burden of taxes which are imposed on more mobile forms of capital, for example, the provincial corporate and municipal property taxes. Another improvement, and one that is probably much more difficult to achieve, would be the grafting of more spatial dimensions onto the model. Transport costs, for example, act as a barrier to interregional trade and can affect the mobility of capital in ways that we have not taken into account. To illustrate this point, consider the decision of a corporation on whether it should relocate in the face of a higher provincial corporate tax rate in the province where it resides. If its market was confined to the province of residence, and if transport costs from an alternative site in another province were high, it would probably not pay to relocate. Rents earned by the company, or the factors it employs, would probably decline instead.

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[6] This is the scenario that Peter Mieszkowski, op. cit., attempts to model in his widely cited paper.

[7] To the extent that immobility is simply another way of defining the absence of many options or opportunities, we might be entitled to speculate that the group of relatively immobile labor would be comprised mainly of low wage earners. If this is true, a higher rate of tax on provincial corporate incomes or provincial property may be particularly onerous for low income groups. Thus, while the property tax may be progressive if levied on a nationwide basis, it is likely to be regressive if applied at the local level at a differentially higher rate.

The problem with all the preceding suggestions is that they assume the existence of a richer body of regional data than actually exists. Barring any breakthrough on the data front in the near future, it might be asked what can be done in the meantime. Our experience indicates that perhaps the most fruitful approach is to apply the nationwide model which we have developed for the federal revenue-sharing experiments to the province or municipality whose change in fiscal circumstance is to be examined. That is, what we have referred to as the country in the federal revenue-sharing experiments could be conveniently and profitably relabelled as the relevant province or municipality, with the data we have used being adjusted accordingly. Capital and labor would move into or out of the area, depending on whether the fiscal change raised or lowered the net factor return, with the understanding that it is the real net return which is relevant for labor migration. Also, provincial tax changes would be measured as deviations from the national average rate. This conception of the problem is more in line with a partial equilibrium framework rather than the general equilibrium framework with which we have worked so far. The cost of abandoning the general for the partial approach is that one would be unable to make very strong statements about the national incidence of local fiscal changes. Perhaps, however, this is better than not being able to say very much about the local incidence of local fiscal changes.

Chapter 7

Summary, Conclusions and Qualifications

Part I: Introduction

No study of such a complex issue as the incidence of governmental tax and expenditure policies can supply final and complete answers. Our efforts must be taken as comprising only a step in what we believe to be the right direction. Nonetheless, our results do suggest some broad conclusions on many important issues, including the impact of factor taxes (such as the corporation income and property taxes), of sales taxes, the significance of expenditure incidence, and the exporting of tax burdens.

This final chapter provides an overview of our work. First, we summarize the basic methodology which we have followed. While that methodology is by no means original, in our view it does comprise an important element of the "step in the right direction" aspect of our study. Second, we review the major conclusions of our analysis. Our intention in that review is not to list once more the results of each experiment but to use those results to extract some broad conclusions about the impact of potential changes in fiscal policy in Canada. Next, we consider what might be the most important extensions of our model and the effect that such extensions may have on our results. This is followed by a brief discussion of some of the efficiency aspects of the various revenue-sharing proposals that we have analyzed. Finally, we weigh the relevance of these proposals against the background of the recent restructuring of fiscal relationships in Canada.

Part II: The Methodology

The word methodology encompasses so much that it is often difficult to describe precisely its meaning for a particular study. We will not attempt a general characterization of our methodology here but will, instead, point out some specific aspects of our approach which distinguish it from its predecessors and which we think should be included and improved upon in future studies of fiscal incidence. Certainly the most crucial element of our approach is the fact that the analysis is based on an explicit model. Consequently, there can be no uncertainty over what is assumed about the behavior of agents in the economy, what constraints those agents face, the kind of competitive conditions found in the economy, and so forth.

Not only does the use of a model require a precise description of whatever assumptions are made, but also, in using the same model for all our experiments, a consistency is imposed upon our results which may not apply to studies that are bereft of any model. For example, a study which allocates tax burdens, using rules of thumb, inevitably creates doubt about whether the results obtained for one tax using one rule of thumb are consistent with the results given by the rule of thumb used for another tax. In our analysis, all of the conclusions are consistent with the behavior described in the single model used to generate our results.

A second important aspect of our approach to the issue of fiscal incidence is the type of model that we have used. A salient feature of modern market economies such as Canada's is the interdependence of the various sectors of the economy. Because of that interdependence, government policy changes which may initially affect only one sector or factor will have repercussions throughout the economy. In order to capture the final economy-wide impact of government policy, we used a general equilibrium model in which all sectors are linked. These linkages run through both the factor and the output markets. In our opinion, it is crucially important that those concerned with the incidence of government policies recognize that the complex interrelationships which exist in the Canadian economy mean that seemingly simple policy changes will have widespread repercussions. An evaluation of the final impact of even simple policy changes requires the use of a functionally explicit general equilibrium model.

However, a model, by itself, is a rather abstract tool. For practical analyses of policy issues, a sound empirical base must accompany the model and be incorporated into it. As the discussion in Chapters 2 and 3 has revealed, an attempt to construct a model which can be used for a realistic analysis of government policy inevitably requires a compromise between the desire to construct an elaborate model and the need to obtain an accurate empirical representation of the model's relationships. While we would be the first to recognize that there are significant improvements to be made both in our model as a theoretical construct and in the data we have used with that model, we would also argue that future work on fiscal incidence should use an explicit model which is not only theoretically robust but which can also be used to generate numerical results based on available data.

There is one final aspect of our general approach to the problem of fiscal incidence which we feel should be incorporated in future work on that subject. Since Parliament and government agencies debate the effects of potential changes in government policy rather than the overall impact of all government policies, research which is relevant to policy debates must examine the effects of policy changes. In a very general and historical evaluation of a particular society, it may be important to attempt to understand the overall impact of government activity on the well-being of different groups in the economy. However, such studies are irrelevant for policy analysis. As it was our goal to shed some light on current policy debates in Canada, particularly the debate over the effect of a greater reliance on federal taxes to finance transfers to local governments, we have used our model to evaluate quite specific tax and expenditure policy changes. The model was tailored to fit these specific policy changes. If other types of changes were being considered, a different model, or a modified version of ours, would be appropriate.

At least for some purposes, a restricted general equilibrium approach may be preferable. It seems to us that a more partial equilibrium analysis may be profitably applied to the examination of many fiscal issues which arise at the provincial and municipal level. In part, this view stems from the difficulty which we experienced in applying the general equilibrium model to provincial fiscal changes. But one of the major sources of our difficulty is at the same time a cornerstone of partial equilibrium models. The latter assumes that prices outside of the market that is being examined are constant. In the small, open economies that are characteristic of all municipalities and most provinces, this price constancy will be maintained by the presence of a large number of tradeable goods and a national market for most local production. It also means one can fruitfully analyze fiscal changes in terms of the adjustments which take place within a fiscal jurisdiction between its tradeable and nontradeable goods and services sectors. That is, one could use essentially the same set of relationships we have developed for the country as a whole and apply them to a new unit of analysis, the province or the municipality. However, this step is not possible at the moment in view of the fearsome data constraints which currently exist, and we are not optimistic about the future availability of the requisite data.

Part III: The Principal Results

Our results indicate that the most progressive source of finance in the Canadian tax system is the personal income tax. Though the corporation income tax is legally assessed against the equity income of stockholders and, though stockholders generally have incomes well above average, the actual incidence of that tax is not as sharply progressive. To suggest that the corporation income tax is borne by stockholders, and is, therefore, a progressive tax, is to ignore the linkages and interrelationships which we have just argued are so important in a modern economy. As long as corporations must bid for capital in the same basic market as other firms, the risk-adjusted return paid to capital, net of all taxes, must be the same in all sectors. This means that the long-run burden on stockholders, of a corporation income tax, will be the same as that on all other capitalists.

While it is true that owners of noncorporate capital will bear the same burden as stockholders, when all the final adjustments are made in the economy, it is possible that the burden borne by all capitalists may be much less than the total burden of the tax. That is, landowners, laborers, and consumers as a group may bear some of the tax burden. However, according to our results, little of the burden is spread to those groups and, in fact, the tax is borne largely by capitalists.

There is one important exception to this conclusion. The repercussions of the tax on the output markets are such that the prices of housing and agricultural goods fall. This implies a modest real income gain for those in the lowest income group because they spend a very high fraction of their income on those two commodities. For all other income groups, the fall in the rate of return to capital dominates any other price effects and, thus, the tax can be generally described as being borne by capitalists.

Given that the tax is borne by capitalists, all that is necessary to determine the incidence pattern is knowledge of the distribution of the ownership of capital by income class. Our data suggest that the lowest and highest income groups receive a larger share of their income from the earnings of capital than do middle income groups. Consequently, there is a U-shaped distribution of the tax burden by income class. With the exception of the very lowest income group where, as just noted, a slight gain is enjoyed, the lower income groups and the highest groups pay the highest effective tax rates while, over a broad range of middle income groups, the tax burden remains roughly constant.

The other major tax instrument which we considered is the property tax. Unlike the corporation income tax, the property tax falls on land as well as reproducible capital. However, as in the case of an increase in the corporation income tax, the many output adjustments resulting from an increase in property taxes do not have a large impact on the incidence of the tax. Indeed, since the property tax raises the prices of housing and agriculture, the U-shaped incidence pattern is sharpened at the bottom end of the income scale as compared to the incidence pattern of the corporation income tax.

In summary, the personal income tax is markedly progressive while property and corporation income taxes have a more mixed incidence pattern. Ultimately, the latter two taxes are borne by owners of reproducible capital and land, and the distribution of the tax burden by income class depends crucially on the distribution of the ownership of capital by income class. As indicated in Chapters 3 and 5, the available data on the ownership of wealth in Canada is weak. In the next section, in which important extensions of our analysis are discussed, we will argue that it is important not only to improve that data but also to adopt a lifetime income base for distributing tax burdens when dealing with taxes on capital income.

A comparison of our results for the use of a given tax to finance different expenditure programs indicates that, despite the potential significance of what we have called expenditure incidence, the effects in Canada of different expenditure policies are slight. For example, raising the corporation income tax to finance an across-the-board increase in government expenditures has basically the same effect on prices and rates of return as using the extra revenues to increase welfare subsidies or to increase urban transit expenditures.[1]

While expenditure incidence played a very small role in our results, we must stress that this conclusion may not hold if the model is disaggregated further and if the data is improved. Essentially, the minor impact of the different expenditure programs arises from the fact that our data do not show marked differences in capital-labor intensities among the different outputs.[2] Disaggregation would almost certainly reveal a greater diversity of capital-labor ratios and, consequently, might well permit a more significant role for expenditure incidence.

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[1] Of course, since the experiment in which welfare transfers are increased explicitly includes much of the benefits in the calculations of the resulting change in incomes, that experiment appears to have had markedly different results from those which raised either general expenditures or transit expenditures. However, the underlying change in factor earnings was very similar in all three cases.

Our conclusions show that while the personal income tax imposes little foreign burden, the foreign burden of an increase in corporation income taxes ranges from 25 per cent to 50 per cent of the increase in government revenues. The reason for the very large foreign burden is the tax-induced increase in the price of exports in which Canada has some monopoly power. Essentially that tax increase allows Canada to exploit some of its monopoly power, thus achieving a gain at the expense of other countries, due to the better terms of trade.

Property taxes also impose a significant foreign burden, but for different reasons. The property tax falls most heavily on sectors other than the corporate sector. That tax reduces the return to capital enough so that the gross of tax return in the corporate sector falls. Since it is the gross of tax return which is received by foreigners, this fall imposes a burden on them. That burden is mitigated somewhat by the fall in the price of the output of the flexibility priced export sector. That sector, like the corporate sector, pays relatively little property tax.

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[2] Note that since some sectors do not use land at all, the land intensities of production among the different sectors do differ significantly. As a result, different expenditure programs do produce sharply different changes in the rate of return to land. However, since land income is only a small fraction of total income, this does not have much influence on the overall results.

Our evidence on the exporting of burdens to foreigners is sufficiently strong to indicate the importance of further work on this matter.[3] The tariff policies of Canada and the countries with whom she trades should be taken into account, as well as the possibility that Canadian exporters are already exploiting some of their monopoly power so that further significant gains cannot be made through tax-induced export price increases.

We found that the international linkages are important, not only in that considerable exporting of taxes may occur, but also because movements of physical capital into and out of Canada resulting from fiscal policy changes may have a significant impact on the effects of those policies. This impact is masked somewhat because, given the level and type of aggregation in our model, a corporate or property tax increase affects all sectors at least partially. Consequently, part of a corporate tax increase falls on profits in all sectors and, thus, is basically a general tax on all capital which leaves the cost of corporate capital unchanged and induces no foreign capital flow. However, if one isolates the effect of the extra tax increase that is paid in the corporate sector due to a rise in the corporation income tax, then our results show that an inflow of foreign capital may increase the fall in the net of tax return to domestic owners of capital by up to 30 per cent.

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[3] In a very ambitious project, John Whalley is examining the international aspects of domestic tax policies in the U.S., Japan, the E.E.C., and the rest of the world. See John Whalley, "Discriminatory Features of Domestic Taxation Policies and Their Impact on World Trade: A General Equilibrium Analysis", paper presented at the Econometric Society Meetings, August 31, 1978, in Chicago, Illinois. Ultimately, a thorough understanding of the international effects of Canadian tax policies will require a merging of work, such as ours, focusing on Canada, with studies such as Whalley's describing a world economy.

Our estimated rates of tax exporting, typically in the range of 25-43 per cent, are not markedly different from those obtained by McLure for the U.S. His average, long-run rate for state corporate taxes is 48 per cent, for example. See Charles E. McLure Jr., "The Interstate Exporting of State and Local Taxes: Estimates for 1962", National Tax Journal, Vol. 20, No. 1, March 1967.

Even though our experiments dealing with provincial revenue-sharing leave much to be desired, some conclusions can be drawn from them. The output changes indicated in our model, which result from one province changing its property or corporate tax rate, while all other provinces leave theirs unchanged, are unbelievably large; nevertheless, those results emphasize the importance of tax harmonization among provinces. We realize that in the actual Canadian economy slight differentiation of products as well as the existence of different natural resources in each province will reduce the output changes indicated by our model. However, for many particular industries large output changes will occur, indicating that regional tax differences may well work against a provincial distribution of output based on comparative production advantages.

The one tax which does not markedly distort location decisions and, thus, the one tax which might best be used by a province, without harmonizing its policies with those of other provinces, is the sales tax. Our results show that provincial sales tax increases are essentially forward-shifted and, consequently, are borne by consumers who purchase products in the province with the higher tax.

Two important implications follow from these findings. Because of the high degree of interprovincial factor mobility and the absence of interprovincial trade barriers, provincial taxes on the sources of income will exert their influence primarily on the side of the uses of income. That is, relatively higher provincial income taxes will cause supply adjustments that raise the cost of hiring factors of production--until equality of after-tax returns is restored across provinces--and thus boost the price paid by consumers of provincial output. Therefore, as a general rule of thumb, provincial changes in a given income tax will be less progressive in their incidence than federal changes in the same tax base. A corollary to this statement is that the more open a fiscal jurisdiction is, the smaller is its ability to impose tax changes that have significant redistributive effects.

It is important to see why this tax-shifting mechanism fails to operate at the national level in the case of internationally mobile capital. Corporate income taxes are, in our view, borne by owners of capital. As a first approximation, we believe that international taxation treaties ensure that higher income taxes will be reflected in lower factor earnings, since any tendency towards larger domestic pretax returns will be limited by competition from imported capital services. It is this institutional feature of current international tax law that distinguishes the impact of a national change in corporate income taxes from a provincial change.

In this summary of our broad conclusions, the benefit incidence results have not been discussed. This is not because the issue of benefit incidence is unimportant but rather because those results are so tentative that they cannot be highlighted as part of the broad general lessons learned from our study.

Our analytical excursion into this area suggests, but hardly proves, that a proportional expansion of all local public services, and even conditional grants to support local welfare and transit systems, will yield benefits that are more progressive in their incidence than was previously considered to be true. Recognition of substantial benefits to donors from transfer programs and empirical evidence of an income-elastic demand for local services are the main factors responsible for this revised assessment of expenditure policy. If this new view is correct, it implies that, contrary to earlier studies, more redistribution may be achieved on the tax than on the expenditure side of the public sector budget. A further implication of this tentative conclusion is that the redistributive consequences of many, if not most, marginal changes in fiscal policy will be extremely modest. In all of our varied experiments, when benefits were distributed either in proportion, or more than in proportion, to income, there were few instances in which a significant or sharp redistribution of real income could be detected. As discussed in the next section, the issue of benefit incidence begs for additional attention.

Part IV: Important Extensions of the Analysis

As mentioned at the beginning of this chapter, our work is, at least, a first step in an effort to develop a fuller understanding of fiscal incidence in Canada. In this section we point to a few of the most important steps that should be taken in the future.

Our analysis has focussed on long-run adjustments to changes in tax and expenditure policies. The long-run nature of the model comes largely from our assumption that capital is mobile between sectors. At the same time we have used a static model which assumes that the economy does not grow. Consequently, there is a certain inconsistency in our analysis. Large-scale changes in the proportion of the economy's stock which is employed in different sectors must come about through changes in the pattern of new investment and not through an actual transfer of physical capital between uses. It is, therefore, important to design a large-scale growth model to check the fiscal incidence results of our static model. Unfortunately, it is also extremely difficult to construct and manipulate such a model. The issue of tax incidence alone in simple one- and two-sector growth models is just now being explored fully; the construction of more elaborate models must await further work.

Along with extending the analysis to a growing economy, it is important to attempt to calculate the distribution of tax burdens by lifetime incomes. An important aspect of our results was the conclusion that low income groups bear a fairly high share of the burden of capital taxes, such as the corporation income tax and the property tax. This apparent regressivity at the low end of the income scale may be illusory. Those who own considerable capital but have small current incomes are very likely to be retired persons who earned sufficient income during their working lives to allow them to accumulate capital. It is not at all clear that a high tax, as a fraction of current income for such individuals, should be classified as regressive. A proper approach to this issue requires both better data on the ownership of wealth and a model which incorporates a life cycle model of individuals' incomes and their savings behavior.

There are several other improvements in our basic model and our use of that model which should be the subject of future research. More disaggregation in all aspects of the model will serve as a useful check on our results. This is important because it is the diversity in the way in which people earn their income and spend it that accounts for the ability of fiscal policy to redistribute income. Any aggregation process which obscures this diversity acts to understate the extent of any redistribution. Moreover, input-output flows could be explicitly integrated into our model instead of being grafted onto it. Although it would increase the cost of obtaining a solution to the model, recognition of some opportunities for substitution between primary and intermediate inputs would also make the model more interesting.[4] The accuracy of our results can also be improved by using some type of fixed-point algorithm to compute the exact, definite changes induced by fiscal policy changes instead of relying on linear approximations as we do.[5] In addition, analysis of the impact of the corporation income tax can be improved upon by taking into account the financial policies that firms follow, particularly their option of using debt finance in order to avoid the tax.[6]

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[4] For an enlightening study which builds these interindustry flows directly into a general equilibrium model, see Robin W. Boadway and John M. Treddenick, "The General Equilibrium Effects of Commodity Taxes in an Economy with Inter-Industry Flows", Public Finance Quarterly, Vol. 5, No. 3, July 1977, pp. 303-28.

Probably the most important area for further work on the subject of fiscal incidence is the enormously complex set of issues surrounding benefit incidence. What is really required are careful empirical studies of the demand for all different types of government services. As we have indicated in Chapter 4, this is much easier said than done. The demand for government services is not revealed in the market, so that one must resort to somewhat dubious attempts to determine what people would be willing to pay for such services. What is presently known in this area is dwarfed by the extensive reaches of the unknown.[7]

It is inevitably true that the data used in a study can be improved upon. Three specific areas in which better data would have allowed us to place much more confidence in our results are the factor proportions employed in the provision of government services, the degree of product differentiation between regions, and the use of immobile specialized factors (e.g., natural resources) in different regions. Better data in the last two areas is especially necessary before more convincing analysis of the impact of provincial tax policies can be completed.

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[5] However, it should be noted that several studies which have checked the accuracy of similar linear approximations for U.S. data have found that such approximations are reasonably accurate.

[6] Rules regarding the taxation of "thinly capitalized" firms in Canada illustrate the importance of this point.

[7] The process of benefit-shifting through changes in asset values and the possibility of benefit-exporting merit a high priority in future research.

In addition to having more accurate information on wealth holdings, it would be desirable to have this data classified according to age of the asset owner and by type of asset held. If this were done, we expect that the U-shaped incidence profile obtained for our capital taxes would vanish and be replaced by a profile displaying, for each age cohort, a burden that increased *pari passu* with the level of income. We would also no longer be forced to assume that the distribution of land ownership by income class was the same as that for total wealth.

In the previous section it was emphasized that in almost none of our experiments were we able to discover a pronounced redistribution of income. A more marked pattern might be revealed, however, if it were possible to disaggregate within the top income bracket, defined, it will be remembered, to include those earning more than $15,000 in 1969. Our present inability to segregate the rich from those who are only moderately well-off no doubt serves to bias downwards our measurement of the change in the size distribution of real household incomes.

Our choice of functional relationships in structuring the model and our selection of at least some parameter values would likewise benefit from advances in economic theory and more elaborate empirical work. For instance, the connection between business taxation and international capital flows has received scant attention. Our simple specification of this relationship assumes that foreign controlled firms either possess excess tax credits or confront a tax rate in their native country that exceeds the tax rate established in Canada. In so far as neither assumption is correct, an alternative specification might link the level of foreign capital employed in Canada to the after-tax return earned in Canada. As mentioned earlier, the incidence of a higher corporate income tax would be quite different in these circumstances from what we have suggested it would be. In the same vein, we have assumed the absence of any international labor mobility and this could conceivably impart some bias to our conclusion that the personal income tax is the most progressive of all sources of public finance. Finally, we must confess some ignorance about the degree of interprovincial factor mobility that exists. We assume that, language barriers aside, it is apt to be high within a federal country, but we are able to point to only very slender evidence to buttress our contention. We await the results of future research to either confirm or deny many of the behavioral assumptions which lie at the heart of this study.

Part V: Fiscal Federalism and Economic Efficiency: Some Neglected Issues

Any proposed division of expenditure and taxation responsibilities among different tiers of government ordinarily requires that some compromise be made between considerations of equity and efficiency. Questions of economic efficiency have been relegated to footnotes in previous pages. In this section we attempt partially to redress this imbalance.

Our federal revenue-sharing experiments involve centralizing tax finance and decentralizing expenditure decisions, a change which could potentially bring the criteria of efficiency and equity into conflict. Centralization of taxation may be desirable on equity grounds if federal taxes are on balance more progressive than those levied by either provincial or municipal governments. There may also be clear gains in efficiency if federal taxes serve to avoid the distortions in location decisions produced by a diverse set of provincial taxes. Federal individual and corporate income taxes are applied uniformly to every region and thus impose automatic tax harmonization. Moreover, the decentralization of expenditures may also represent a gain in economic efficiency by allowing the level and composition of government expenditures to vary more freely in accord with regional tastes for public goods.

However, the scheme has one glaring fault: it violates a basic principle of public finance which states that each jurisdiction should determine and pay for those services, the benefits of which are confined to residents of that particular area. If, for example, municipal governments pay for only a small portion of the services they provide to their constituents, they will be encouraged to offer more services than strict efficiency considerations would dictate are desirable.[8] Thus, federal finance may be the most efficient method of providing a fixed level of local public services but any gain realized on this score must be weighed against the blanket invitation to overexpand the level of these services. Note that this last issue concerns the proper balance between the scope of private and public activities; it is quite independent of the question of how alternative tax regimes affect the economic efficiency of private sector decisions (the so-called excess burden of taxation).

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[8] As with all discussions of efficient resource allocations, the arguments are conditional upon what is assumed about initial conditions. If local public goods were initially undersupplied, the expansion of the local sector induced by central finance would promote rather than hinder economic efficiency. For some evidence, not too persuasive, that undersupply may be the relevant case; see Barlow, op. cit., and Bergstrom and Goodman, op. cit.

Our experiments also illuminate two other aspects of the goal of economic efficiency in a federal system, namely, which tier of government should be assigned a particular expenditure function and, once that decision is made, what form the expenditure should take. To illustrate the former problem, consider the assignment of welfare expenditures. With a high degree of interprovincial labor mobility, a strong case can be made for lodging this function exclusively with the federal government. Otherwise, if the level of welfare payments varies by region, the mobility of labor from jobs in less productive areas to higher paying jobs elsewhere may be impeded and taxpayers' residential choices will be distorted. Improving the allocative function of wages is a strong argument for federalizing the welfare system.[9]

As an example of the need to choose the proper expenditure form, consider the subsidy offered to consumers of urban transit services. The objective of this subsidy is to relieve the congestion on crowded urban roads and reduce the air and noise pollution associated with the use of the private automobile. Since direct pricing of scarce road space is technically difficult, road use may be indirectly taxed (priced) by subsidizing alternative transport modes which economize on the consumption of road services.[10] If there is a reasonably high degree of consumer substitution between the subsidized and unsubsidized transport modes, and if, at the same time, there is not much substitutability between transport services and other goods and services, the subsidy will lead to an improvement in resource allocation.[11]

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[9] Whether or not this is a serious concern depends on the responsiveness of migration to differences in regional levels of welfare benefits. It is possible that people outside the labor force, the retired, for example, may be more apt to move in search of higher benefits than those who are members of the labor force, in which case the locational impact of varying benefit levels would be mitigated. For some empirical evidence on this matter see Courchene, op. cit.

It is not clear, however, that this indirect method of taxing the private automobile is a very close substitute for a direct tax. The problem is that, if the subsidy succeeds in diverting travel from the car to the bus, it also automatically diminishes the private cost of using automobiles. But if this private cost declines, the subsidy device becomes a poor substitute for a direct tax which would increase the cost of motoring.[12] Any reduction in the cost of motoring, on the other hand, will raise the demand for motoring. It is likely, therefore, that any abatement in road congestion will stimulate more motoring until the original level of congestion is restored. If the reduction in congestion, attributable to the transit subsidy, is ephemeral, so too will be the indirect benefits of the subsidy. Only a direct increase in the cost of motoring seems to offer much hope for a permanent reduction in the use of private automobiles. In other words, the ultimate impact of the subsidy may be limited to a redistribution of income in kind, which recipients of the subsidy would probably consider to be worth less than the value of an equal-cost transfer of income. In the absence of donor benefits, tied income transfers are generally inferior to unconditional ones.

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[10] A subsidy should be viewed as a negative tax. Thus, if two objects compete in demand, a subsidy to one of them is equivalent to a tax on the other.

[11] This is the second-best rationale for the subsidy. Introducing one distortion (the subsidy) may be beneficial if it helps to alleviate the undersirable effects of another (congestion).

[12] This argument has been cogently stated by D. Dewees, "Travel Costs, Transit and Control of Urban Motoring", Public Policy, Vol. 24 Winter 1976. He also offers a convincing demonstration of the absence of any perfect solution and suggests that some combination of downtown parking taxes, urban expressway tolls, gasoline taxes and registration taxes must be employed to raise the private cost of motoring to individuals.

An interesting and worthwhile exercise would be to calculate the tradeoff, if any, between equity and efficiency that may arise among alternative methods of attaining the objectives of public policy. This is the kind of information which we believe is vital in selecting the best alternative from the array of mutually exclusive solutions that are normally available to policy-makers.

Part VI: Asking the Right Question: The Relevance of Our Experiments

We cannot emphasize too strongly the contextual nature of the study of fiscal incidence. The incidence of a tax increase will always depend on what other tax is being replaced or, if larger expenditures result, it will depend on how governments make use of the proceeds. To some, this approach will seem chaotic, an abandonment of the search for general answers and an acceptance of incidence analysis as a large catalogue of specific cases. We sympathize with the desire to develop a tidy body of knowledge in this area but also feel convinced that any attempt in that direction will only minimize the contribution of economic analysis to public policy debate. For instance, to evaluate the effects of a particular tax increase by comparing it to a reduction in a neutral equal-yield tax is simply being unrealistic. Since the neutral tax alternative does not exist in any economy, the preceding evaluation will fail to indicate what really happens when the tax increase occurs. What is needed, we believe, is an assessment of the consequences of replacing any of a large set of non-neutral taxes with the revenue from the proposed tax increase. To us, it is more important to be relevant than to be tidy.

Achieving relevance, however, is easier said than done. It is frequently as difficult to know if the right question is being asked as it is to obtain satisfactory answers. To appreciate this problem of choosing the appropriate counterfactual situation, consider our experiment in which higher municipal expenditures were financed by an increase in the federal personal income tax. If municipal governments would have increased their spending in any event and financed it with property tax revenues, the relevant context is the differential incidence of substituting an increase in the personal income tax for an increase in the property tax. It is possible that many fiscal issues that appear to be balanced budget questions may be better suited to a differential incidence treatment. Similarly, the effect of increased unconditional grants on the budgets of municipal governments may be partly substitutive (tax-reducing) and partly stimulative (expenditure-raising), in which case the outcome will be a weighted average of the results reported for the differential and balanced budget incidence experiments.

In selecting the proper context, it is necessary to consider the scope of any tax change and, perhaps, the subsequent reactions to it of other levels of government. For example, if all provinces are contemplating the same tax change, a national rather than provincial perspective is called for in analyzing the consequences. As another illustration, if provinces raise their rates on the corporate income tax to finance municipal grants, but the federal government responds by sharing more of the corporate tax base with the provinces and recouping its loss with higher personal income tax rates, the effective change in tax structure is between the individual income and property taxes. Most appeals for property tax relief would give rise to a similar kind of tax substitution.

How closely do our experiments parallel recent changes in Canada's fiscal federalism? While the federal government has refrained from offering unconditional grants to municipalities, it is clear that, with the exception of Alberta, all the provinces are moving towards greater unconditional revenue-sharing with their municipalities. New Brunswick is unique in that the bulk of its financial assistance to municipalities represents unconditional transfers. Quebec is also distinct in sharing its retail sales tax base, but only that particular base, unconditionally with its municipalities. In Manitoba, two percentage points of the personal income tax and one percentage point of the corporate income tax provide an unconditional source of municipal finance. The governments of British Columbia and Saskatchewan have recently announced new revenue-sharing programs for their municipalities. In Saskatchewan the program is to be restricted initially to rural municipalities. The more broadly based program in British Columbia will channel, annually, one personal income and one corporate income tax point plus six per cent of revenue from natural resources and sales taxation to the municipalities. In Ontario, a recent document, the Report of the Provincial-Municipal Grants Reform Committee, advocates placing greater reliance on unconditional grants along with the deconditionalization of many current grants. In addition, the provincial government made the so-called Edmonton Commitment a part of its 1974 budget in which it pledged to "pass on to local governments the full benefits of any net gains in new unconditional tax sharing by the provincial government." Analyzing past and prospective shifts in Canada's fiscal structure is never going to be an easy task. Our wish is that the modelling exercise in this study will enhance our understanding of at least some of the main effects associated with these fiscal trends. Until we have a clearer idea of who is helped and who is harmed by these trends, it will be impossible to achieve a more rational fiscal system.

Appendix A

List of Variables and Equations

This appendix has two purposes. One is to provide a comprehensive list of the extensive notations found in Chapters 1 - 4. The other is to set out a complete set of equations describing the interregional model that is discussed in Chapter 2. A "hat" symbol (ˆ) denotes a percentage change in the variable concerned.

I. List of Variables Used in This Study

a) Output Variables

The following capital letters denote the production and consumption of final goods:

H = level of housing services produced and consumed in Canada.

T = level of urban transit services produced and sold in Canada.

Z = level of commercial services produced and sold in Canada.

C = amount of corporate final goods produced and consumed in Canada.

A = amount of final foodstuffs produced and sold in Canada.

E = domestic production and foreign consumption of flexibly priced exports.

F = domestic production and foreign consumption of fixed-price exports.

M = foreign production and domestic consumption of imports.

G = government production of nonmarketable local public services.

A subscript "d" attached to any of these variables refers to the amount demanded by consumers and is used to distinguish, where necessary, production from consumption. A subscript "K, L or N" denotes the marginal product of that output with respect to capital, land and labor, respectively.

b) Input Variables

$\bar{L}$ = total amount of land in the economy.

$\bar{N}$ = total amount of labor in the economy.

$K = K_f + K_n$.

K_f = foreign-owned capital.

$\bar{K}_n$ = domestically owned capital.

The "bar" symbol (-) indicates that the total supply of the resource is fixed to the economy. A subscript with an output designation, K_E, for example, is used to specify the amount of a resource which is employed in a certain part of the economy. Thus, K_E above is the amount of capital (domestic and foreign-owned) that is used in the production of flexibly priced exports (E).

c) Price and Income Variables

I = total national income gross of taxes (or inclusive of government sector income).

I_j = disposable income of the j'th income class.

e = the international exchange rate (number of units of domestic labor, the numeraire, to foreign currency or imports).

P_i = net or after-tax price received by a factor of production or a producer of output. P_c, for example, is the price of output net of all indirect taxes. P_K, for example, is the net price of capital before personal income taxes but net of all capital taxes.

P_i^* = gross of tax price paid by consumers in the case of output or by employers in the case of inputs. Since subsidies are treated as negative taxes, P_i^* may also refer to a gross of subsidy price for either outputs or inputs.

T_x = level of total tax revenue (government sector income).

R = level of real national income (total money incomes deflated by an appropriate price index).

V_i = the value of the i'th input or output. Thus, for example, the value of housing services produced and purchased is $V_H = P_H H$ and net capital incomes in that particular sector are $V_K^H = P_K K_H$.

II. Notation for the Interregional Model

All of the previous notation applies, except that here the superscripts p and r are invoked to distinguish geographic location. The superscript "p" refers to an activity (a level of production or price paid) in a particular provincial location, while the superscript "r" performs the same service in the rest of Canada. A new variable is introduced for this model, M_{ij}. It expresses the amount of fiscally induced labor migration from the j'th to the i'th area or region of the country.

III. List of Parameters Used in This Study

a) Behavioral Parameters

ε_{ij} = the compensated price elasticity of demand for the i'th commodity with respect to a change in the j'th commodity price, assumed to be the same for all income groups.

θ^{i} = share of total disposable income spent on the i'th commodity.

θ_{ij} = the value or cost share of the i'th factor of production used in the production of the j'th output $\sum_{i=1}^{n} \theta_{ij} = 1 \ \forall j$.

σ^{k}_{ij} = the partial elasticity of factor substitution between the i'th and j'th factors used in the production of the k'th output. An unsubscripted value, σ^{k}, is used for those outputs employing only the two factors of capital and labor in production.

η = price elasticity of foreign demand for flexibly priced exports.

γ_{K} = elasticity of the stock of foreign capital employed in Canada with respect to the gross return to capital in the corporate sector.

γ_{L} = elasticity of the relative supply of land in housing, as opposed to agriculture, with respect to relative net prices for land.

h_{i} = income elasticity of demand for the i'th output, assumed to be constant for all income groups.

$\hat{J}_i$ = the income effect in the uncompensated demand function for the i'th output (the percentage change in demand for the i'th output attributable to real income changes).

α_j^i = fraction of disposable income of the j'th income group spent on the i'th output.

μ = the marginal utility of income.

α = the elasticity (with respect to income) of the marginal utility of income.

ϕ = the elasticity of wealth with respect to income.

σ = average elasticity of substitution in demand.

b) Policy Parameters

S_i = ad valorem subsidy rate applied to the i'th output or factor of production.

t_s = ad valorem sales tax rate, variable by output sector.

t_c = corporate income tax rate, variable by output sector.

t_K = property tax rate on improvements, variable by output sector.

t_L = property tax rate on land used in housing and agriculture.

B_s = sales tax receipts.

B_x = level of personal transfer payments.

B_p = level of personal income taxes collected.

c) Additional Parameters Appearing in This Study

ϕ_j = share of total capital income received by the j'th income class.

ϕ_j' = share of capital income in the disposable income of the j'th income class.

λ_j = share of total labor income received by the j'th income class.

λ_j' = share of labor income in the disposable income of the j'th income class.

π_j = share of total land income received by the j'th income class.

π_j' = share of land income in the disposable income of the j'th income class.

Ψ_j = the net tax rate for the j'th income class: personal income taxes minus transfer payments as a fraction of disposable income received by the j'th class.

Ω = the net tax rate for the whole economy: total personal income taxes less total transfer payments as a fraction of total disposable income.

η_{vq} = the elasticity of vehicular road speed with respect to the number of vehicles using the road.

β = share of local government expenditures in total government spending (total tax revenue).

IV. Structural Equations For The Inter-Regional Model

a) 1) Production (Supply) and Factor Demand Equations

(1) $H^P = H^P (K^P_H, N^p_H, L^p_H)$

(2) $P^P_K (1 + t_c) (1 + t_K) = P^P_H H^P_K$

(3) $P^{Hp}_L (1 + t_L) = P^P_H H^P_L$

(4) $P^P_N = P^P_H H^P_N$

(5) $T^P = T^P (K^P_T, N^P_T)$

(6) $P^P_K = P^P_T T^P_K$

(7) $P^P_N = P^P_T T^P_N$

(8) $C^P = C^P (K^P_c, N^P_c)$

(9) $P^P_K (1 + t_c) (1 + t_K) = P_c C^P_K$

(10) $P^P_N = P_c C^P_N$

(11) $Z^P = Z^P (K^P_Z, N^P_Z)$

(12) $P^P_K (1 + t_c) (1 + t_K) = P^P_Z Z^P_K$

(13) $P^P_N = P^P_Z Z^P_N$

(14) $A^P = A^P (K^P_A, N^P_A, L^P_A)$

(15) $P^P_K = (1 + t_c) (1 + t_k) = P^P_A A^P_K$

(16) $P^P_N = P^P_A A^P_N$

(17) $P^{Ap}_L (1 + t_L) = P^P_A A^P_L$

(18) $E^P = E^P (K^P_E, N^P_E)$

(19) $P^P_K (1 + t_c) (1 + t_k) = P_E E^P_K$

(20) $P^P_N = P_E E_N$

(21) $F^P = F^P (K^P_F, N^P_F, L^P_F)$

(22) $P^P_K (1 + t_c) (1 + t_k) = P_F F^P_K$

(23) $P^P_N = P_F P^P_N$

(24) $P_L^{Ap} (1 + t_L) = P_F F_L^p$

(25) $G = G(K_G, N_G)$

(26) $P_K^p = P_G G_K$

(27) $P_N^p = P_G G_N$

a) 2) Product Demand Equations

(28) $H_d^p = H_d^p (P_c^{*p}, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(29) $T_d^p = T_d^p (P_c^*, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(30) $Z_d^p = Z_d^p (P_c^*, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(31) $C_d^p = C_d^p (P_c^*, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(32) $M_d^p = M_d^p (P_c^*, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(33) $A_d^p = A_d^p (P_c^*, P_A^*, P_Z^*, P_T, P_H^*, P_M^*, I^p)$

(34) $P_G G = \beta \cdot (\text{total tax revenue})$

a) 3) Trade, Factor Endowment and Income Relationships

(35) $P_E E^p + P_F F^p = P_M M_d^p + P_K K_f^p + P_C (C_d^p - C^p)$

(36) $L_H^p / (L_A^p + L_F^p) = g (P_L^{Hp} / P_L^{Ap})$

(37) $\bar{L} = L_H^p + L_A^p + L_F^p$

(38) $N^p = N_E^p + N_A^p + N_F^p + N_Z^p + N_T^p + N_G + N_C^p + N_H^p = \sum_{i=1}^{8} N_i^p$

(39) $K^p = K_E^p\ K_A^p + K_F^p + K_Z^F + K_T^p + K_G + K_C^p + K_H^p = \sum_{i=1}^{8} K_i{}^p$

(40) $I^p = \sum_i^8 K_i^p P_K^* + \sum_i^8 N_i^p P_N + P_L^{A^*} P (L_A + L_p) + P_L^{H^*} P L_H$

$+ B_s - K_f^p P_K$ where

$B_s = t_s P_M M + t_s P_c C + t_s P_Z Z + t_s P_A A + t_s P_H H$, the total of sales tax receipts

(41) $I^p = P_H^{*p} H + P_c^{*p} C + P_T T + P_Z^{*p} Z + P_G G + P_M^* M + P_A^{*p} A$

(42) $P_N^p = 1$

Some variables are not explicitly defined here. For example, gross product prices (those written with a * notation) could be defined in separate equations which link them to net of tax prices. Similarly, balance equations for nontradeable commodities have been omitted, for example, $A_d^p = A^p$, and, thus, for these items there is no distinction made between the amounts consumed and produced. Finally, the assumption of perfect land mobility between the agricultural sectors A and F is incorporated into equation (24). Equations common to both regions are:

(43) $P_E/e = f(E)$

(44) $P_F = e\bar{P}_F$

(45) $P_M = e\bar{P}_M$

b) Equations Describing the Rest of Canada

b) 1) Production and Factor Demand Equations

(46) $H^r = H^r (K_H^r, N_H^r, L_H^r)$

(47) $P_K^r (1 + t_c) (1 + t_K) = H_K^r P_H^r$

(48) $P_N^r = H_N^r P_H^r$

(49) $P_{LH}^r (1 + t_L) = H_L^r P_H^r$

(50) $C^r = C^r (K_H^r, N_H^r)$

(51) $P_K^r (1 + t_c) (1 + t_K) = C_K^r P_c$

(52) $P_N^r = C_N^r P_c$

(53) $Z^r = Z^r (K_Z^r, N_Z^r)$

(54) $P_K^r (1 + t_c) (1 + t_K) = Z_K^r P_Z^r$

(55) $P^r_{N} = Z^r_N \; P^r_Z$

(56) $A^r = A^r \; (K^r_A, N^r_A, L^r_A)$

(57) $P^r_K \; (1 + t_c) \; (1 + t_K) = A^r_K \; P^r_A$

(58) $P^r_N = A^r_N \; P_A{}^r$

(59) $P^r_{LA} \; (1 + t_L) = A^r_L \; P^r_A$

(60) $E^r = E^r \; (K^r_E, N^r_E)$

(61) $P^r_K \; (1 + t_c) \; (1 + t_K) = E_K \; P_E$

(62) $P^r_N = E_N \; P_E$

(63) $F^r = F^r \; (K^r_F, N^r_F, L^r_F)$

(64) $P^r_K \; (1 + t_K) \; (1 + t_c) = F_K P_F$

(65) $P^r_N = F_N P_F$

(66) $P^r_{LA} \; (1 + t_L) = F_L P_F$

b) 2) Product Demand Equations

(67) $H^r_d = H^r_d \; (P^*_c, P^*_M, P^r_H, P^r_Z, P^r_A, I^r)$

(68) $M^r_d = M^r_d \; (P_c, P^*_M, P^r_H, P^r_Z, P^r_A, I^r)$

(69) $C^r_d = C^r_d \; (P_c, P^*_M, P^r_H, P^r_Z, P^r_A, I^r)$

(70) $A^r_d = A^r_d \; (P_c, P^*_M, P^r_H, P^r_Z, P^r_A, I^r)$

b) 3) Trade, Factor Endowment and Income Relationships

(71) $L^r_H \; / \; (L^r_A + L^r_F) = m \; P^r_{HL}/P^r_{AL})$

(72) $K^r = K^r_H + K^r_A + K^r_F + K^r_Z + K^r_C + K^r_E = \sum_{i=1}^{6} K_i$

(73) $N^r = N^r_H + N^r_A + N^r_F + N^r_Z + N^r_C + N^r_E = \sum_{i=1}^{6} N_i$

(74) $\bar{L}^r = L^r_A + L^r_F + L^r_H$

(75) $P_E \; E^r + \bar{P}_F \; F^r = P_M \; M^r_d + P_K \; K^r_f + P_c \; (C^r_d - C^r)$

$$I^r = \sum_{i=1}^{6} K_i P_K^r (1 + t_c)(1 + t_K) + \sum_{i=1}^{6} N_i P_N^r + L_H^r P_{HL}^r + (L_A^r + L_F^r) P_{LA}^r + B_s - K_f P_K \tag{76}$$

$$I^r = P_M^* M_d^r + P_A^* A_d^r + P_Z^* Z_d^r + P_c^* C_d^r + P_H^* H_d^r \tag{77}$$

c) Interregional Commodity and Factor Supply Relationships

$$C = C^p + C^r \tag{78}$$

$$C = C_d^p + C_d^r \tag{79}$$

$$M = M_d^p + M_d^r \tag{80}$$

$$F = F^p + F^r \tag{81}$$

$$E = E^p + E^r \tag{82}$$

$$K = K^p + K^r \tag{83}$$

$$K^p/K^r = f\,(P_K^p / P_K^r) \tag{84}$$

$$\bar{N} = N^p + N^r \tag{85}$$

$$N^p / N^r = g\,(P_N^p / P_N^r) \tag{86}$$

$$K = \bar{K}_n + K_f^r + K_f^p \tag{87}$$

$$K_f^r = K_f^r\,(P_{KC}^{*r}) \tag{88}$$

$$K_f^p = K_f^p\,(P_{KC}^{*p}) \tag{89}$$

These 89 equations are sufficient to determine the solution to the values of 86 variables when the equilibrium system is subjected to a fiscal shock. There are 42 provincial economy variables consisting of the quantities H^p, K_H^p, N_H^p, L_H^p, T^p, K_T^p, N_T^p, C^p, K_C^p, N_C^p, Z^p, K_Z^p, N_Z^p, A^p, K_A^p, N_A^p, L_A, E^p, K_E^p, N_E^p, F^p, K_F^p, N_F^p, L_F^p, K_G, N_G, G, C_d^p, M_d^p, K_f^r, K^p, K^p, N^p and the prices P_H^p, P_{LH}^p, P_K^p, P_N^p, P_{LA}^p, P_T^p, P_G, P_Z^p, P_A^p and total income I^p.

In addition, there are 34 endogenous variables in the rest of Canada. Twenty-six of these variables are quantities: H^r, K^r_H, N^r_Hm L^r_H, C^r, K^r_C, N^r_C, Z^r, K^r_Z, N^r_Z, A^r, K^r_A, N^r_A, L^r_A, E^r, K^r_E, N^r_E, F^r, K^r_F, N^r_F, L^r_F, K^r, N^r, M^r_d, C^r_d, and K^r_f. Eight of them are the prices P^r_H, P^r_Z, P^r_A, P^r_K, P^r_N, P^r_{LH}, P^r_{LA}, and total income I^r. To round off matters, there are also five economy-wide quantity variables, C, E, F, M, and K, and five price variables, P_E, P_F, P_M, P_C, and C.

Three of the equations contained in the model are dependent. If each region is constrained in its spending by its total income, as is indicated by equations (40), (41), (76) and (77), one of the demand equations in each region is redundant by Walras's law. Moreover, the sum of equations (40), (41), (76) and (77) is the country's balance of payments constraint which, in turn, is the sum of the regional balance of payments constraints shown in equations (35) and (75). Therefore, one of the regional payments constraints can be obtained from the other equations in the model.

Differentiating this large system of equations to generate the reduced form that was used to solve for the results of the fiscal experiments, is an extremely tedious and unrewarding exercise, the flavor of which can be gleaned from Chapter 2 where the smaller model is fully developed.

Appendix B

Derivation of Factor Shares by One-Digit Industry

In Chapter 3, the value-added of the commercial one-digit industries was partitioned into capital tax burdens and payments received by labor, capital and land which were then aggregated to obtain the factor income shares for each final commodity. This appendix discusses the methodology that has been employed to derive the industry division of factor incomes and capital tax payments for the year 1969. Major sources of information consisted of national accounts data and the recent study of the structure of Canada's capital taxes by Glenn Jenkins.[1] These sources were supplemented, where necessary, by numerous other publications of Statistics Canada.

From the national accounts, figures were obtained for the Gross Domestic Product of each one-digit industry while from Jenkins's study were extracted information on gross and net capital incomes in these industries. Labor income or labor's income share is determined residually by combining the two sets of data after some minor adjustments. This is a broad description of our procedure; along the way we were compelled to consider a variety of thorny measurement problems. Among the more perplexing were the following:

(1) the allocation of unincorporated business income to its capital and labor income components. An accurate allocation is especially important

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[1] System of National Accounts. National Income and Expenditure Accounts, Vol. 1, The Annual Estimates, 1926-1974, Statistics Canada, No. 13-531, and Glenn P. Jenkins, "Analysis of Rates of Return from Capital in Canada", Unpublished Ph.D. dissertation, University of Chicago, 1972.

in the agricultural and real estate sectors which are predominantly noncorporate in organizational form and to a lesser, but still significant, extent, in the trade and commercial services sectors. Moreover, in housing and agriculture, capital incomes must be partitioned into land and nonland components.

(2) the determination of reasonable amounts of capital depreciation in each industry. Since Jenkins's capital income data is net of depreciation charges, subtraction of his capital income series from GDP will lead to an overstatement of labor incomes unless some allowance is made for depreciation.

(3) the treatment of property taxes. In the national accounts these taxes are treated as indirect levies and, thus, are excluded from GDP, whereas in our model we consider them to be a form of capital, rather than product, tax.

(4) the size of the commercial services sector. In the national accounts, commercial services, the activity relevant to our model, are not distinguished from those of a non-commercial nature. The latter include health and educational services provided through the government sector and the activities of a large number of welfare, charity, and religious organizations.

(5) the value-added attributable to the services supplied by financial institutions. Past studies have ignored this sector because of the measurement headaches it presents. Due to its role as an intermediary, the usual definition of capital income generated, gross profits plus interest paid minus interest received, does not work for the financial sector. If it were applied, an unrealistically small, perhaps even negative, value-added would result for this sector.

(6) the question of the ownership of capital versus its use. For example, if an insurance company owns and leases a supermarket, the rental income appears in the value-added of the finance and insurance sector where the capital is owned, rather than in the trade sector where the capital is used and where the value-added originates.

We have been at least partially able to overcome some of these difficulties. In using Jenkins's capital income data, we implicitly adopt his assumption in splitting up unincorporated income, namely that the net or after-tax return on capital is the same in both the corporate and unincorporated portions of each industry. Recent empirical studies appear to support this assumption.[2] For depreciation we have relied upon annual capital consumption allowance data published by Statistics Canada.[3] We have no certainty about the accuracy of these data but do know that they are based on calculations of "true" depreciation and not corporate financial statements which are apt to be distorted by tax provisions and historical cost considerations. We have adjusted for property taxes in a simple way by increasing the value of GDP given in the national accounts by the amount of property taxes paid by each industry, as reported in Jenkins's study. We have made no adjustments for capital use, as opposed to ownership, since this defect is one that is inherent in our system of national accounts.

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[2] See, for example, Laurits R. Christensen, "Entrepreneurial Income: How Does It Measure Up?", American Economic Review, Vol. 61, No. 4, September 1971.

[3] Fixed Capital Flows and Stocks, Statistics Canada, No. 13-211.

Our determination of the dimensions of the commercial services sector requires a lengthier explanation. In the most recent description of the input-output table, there is an explicit comparison of labor incomes by one-digit industry, as they are calculated in the national accounts, and as measured in the table.[4] In addition, labor income is broken down between the business and government sectors. From the comparisons provided, it appears that about 34 per cent of labor income earned in community, business, and personal services originated in the private sector in 1966.[5] Applying this percentage to the 1969 national accounts figure for labor income of this sector, yields an estimate of $3,252 mn. as the amount attributable to the private sector. From Jenkins's study, private capital earnings in this sector, inclusive of corporate taxes, was $658 mn. in 1969. Depreciation is estimated to be $303 mn., so gross value-added, exclusive of property taxes, is $4,213 mn. as shown in Table B-1. The addition of property taxes worth $77 mn. brings the adjusted GDP figure up to $4,290 mn. The unadjusted estimate of $4,213 mn., some 32 per cent of the national accounts figure for GDP of $13,020 mn., could be a slight underestimate. A comparison of percentage weights for different sectors' real domestic product indicated that the fraction of output arising in the private sector might be around 35 per cent but it was felt that this small discrepancy was not worth further adjustment.[6]

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[4] The Input-Output Structure of the Canadian Economy, 1961-66, Statistics Canada, Input-Output Division, No. 15-505E, p. 23.

[5] We checked this figure against employment data found in Estimates of Employees by Province and Industry, 1961-1972. Statistics Canada, 1969, No. 72-513. The ratio of commercial to total service employment was found to be .37 for that particular year.

We experienced much greater difficulty in sorting out the value-added contribution of financial services. The first task involved separating the real estate industry from the aggregate of finance, insurance and real estate that is found in the national accounts. In 1969 the accounts give $8,076 mn. as the measure of GDP for the aggregate sector. Subtracting Jenkins's estimate of net paid and imputed rents on nonfarm housing (rents net of property taxes, insurance, repairs and maintenance but gross of mortgage interest, worth $3,759 mn. in 1969) from the total above, results in $4,150 mn. as our measure of GDP originating in financial services. After making some rough adjustments to the wages paid by corporate financial institutions, we estimate the wage bill of the financial services sector as approximately $2,100 mn.[7]

Agriculture is another sector that gives rise to measurement problems. Here the difficulty rests with the imputation that is placed on the value of own-account farm workers. Following Jenkins, we adopt his conservative imputation procedure which assumes that owners and employers receive the paid workers' wage but that unpaid family workers receive a zero wage. With this assumption imputed, farm wages are $1,028 mn. In 1969 which, when added to paid wages of \$313.6 mn., give a wage bill for the sector of \$1,339 mn. We also partition the capital income of this sector into land and reproducible capital components, using the ratio of the value of farm land to the value of total capital.[8] Again, relying on Jenkins's data, we estimate this ratio to be one-half.

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[6] Real Domestic Product by Industry, Statistics Canada, No. 62-213. Thirty-five per cent of the service sector weight represents amusement and recreation, business and personal plus accommodation and food services.

[7] The Statistics Canada publication, Corporate Financial Statistics, No. 61-207, indicates that wages paid by corporate financial companies were $1,535 mn. Using input-output table data on the ratio of supplementary labor income to wages paid in 1966, and making an allowance for the missing coverage of credit unions, caisses populaires and cooperatives, we arrive at the figure of $2,100 mn. as the total wage bill.

The results of our various refinements and our calculations of industry factor shares and effective corporate and property tax rates are shown in Table B-1. In column (7), the numbers in brackets are the national accounts figures for labor payments made in the corporate portion of each industry. As is easily seen, our residual calculation of labor income is appropriately larger, except for forestry and finance, since it includes labor income earned in both corporate and noncorporate parts of each industry. Because his definition of the mining sector may have been too narrow, we were unable to use directly Jenkins's data for this sector. From his estimate of capital income earned in this sector, our residual calculation of labor income exceeded the national accounts figure by about 13 per cent. This is anomalous, given the absence of the unincorporated business form in this sector, so we used the national accounts figure for labor income and instead calculated capital income residually. We did, however, use Jenkins's estimates of effective capital tax rates and applied them to our adjusted value for capital income. In the case of forestry, the discrepancy between the two values for labor income was very small. For the finance sector, the national accounts

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[8] This procedure assumes that the rates of return to land and other forms of capital are the same.

Table B-1

Factor Shares and Effective Tax Rates by One-Digit Industry, 1969

Sector	(1) GDP	(2) Property Taxes	(3) Adjusted GDP	(4) Depreciation	(5) Net Capital Income	(6) Gross Capital Income	(7) Labor Income	(8) Labor Share	(9) Capital Share	(10) Corporate Taxes	(11) Corporate Tax Rate	(12) Corporate Tax Rate
Agriculture	$ 2,607	$ 185	$ 2,792	$ 706	$ 747	$1,453	$1,339(347)	.4	.6	$ -	-.23	.25
Forestry	612	3	615	70	42	112	503(521)	.81	.19	10.4	.26	.076
Mining	2,677	80	2,757	521	1,187	1,708	1,049(1,049)	.38	.62	287	.25	.07
Manufacturing	17,244	251	17,545	1,558	4,194	5,752	11,793(11,754)	.67	.33	1,396	.334	.06
Construction	4,522	31	4,553	218	560	778	3,775(3,371)	.83	.17	106.5	.321	.056
Housing	3,862	1,787	5,649	103	5,546	5,649	-	-	1.00	-	-	.31
Transport	4,144	114	4,258	679	585	1,264	2,994(2,872)	.7	.3	117	.22	.195
Storage	158	7	165	15	33	48	117(113)	.71	.29	4.3	.152	.212
Communications	1,929	52	1,981	297	531	828	1,153(1,128)	.58	.42	112	.21	.098
Wholesale Trade	3,581	59	3,640	143	919	1,062	2,578(2,387)	.71	.29	261	.29	.064
Retail Trade	4,991	155	5,146	200	1,114	1,314	3,832(3,363)	.74	.26	198	.177	.14
Finance	4,150	174	4,324	161	2,050	2,211	2,113(2,360)	.49	.51	391	.191	.085
Commercial Services	4,213	77	4,290	303	738	1,041	3,249	.76	.24	117	.163	.104
Total	54,740	2,975	57,715	4,974	18,246	23,220	34,495			3,000		

Sources

(1) System of National Accounts. National Income and Expenditure Accounts, Vol. I, The Annual Estimates, 1926-1974. Statistics Canada, No. 13-531.

(2) Glenn P. Jenkins, "Analysis of Rates of Return from Capital in Canada". Unpublished Ph.D. dissertation, University of Chicago, 1972.

(3) The sum of columns (1) and (2).

(4) Fixed Capital Flows and Stocks, Statistics Canada, No. 13-211.

(5) Jenkins, op. cit., Net Capital Income includes corporate income and property taxes. Finance, housing and mining differ from Jenkins, as explained in the text.

(6) The sum of columns (4) and (5).

(7) Column (3) minus column (6). The numbers in brackets are the labor income figures recorded in the national accounts.

(8) Jenkins, op. cit.

value for labor income includes the real estate sector which we have incorporated into our housing sector and which, therefore, should be somewhat larger than our estimate.[9] Also, in the case of finance, our estimate of capital income does not agree with Jenkins's value, ours being about 38 per cent smaller than his, since he used a quite different measurement basis. Here again, however, we adopt his estimates of effective capital tax rates.

In Chapter 3 we allocated a fraction of the capital income earned in housing to land. From Jenkins's data we determined that, for all of Canada, the value of land as a proportion of the value of nonfarm residential housing was .336. Another study suggested that the proportion of the value of owner-occupied residential real estate attributable to land was .25.[10] We felt these figures were in close enough agreement to allow us to compromise and therefore took .3 as the fraction of capital income in housing attributable to land. This procedure assumes that land and other forms of capital in housing earn the same rate of return.

Our labor and capital share estimates are reasonably consistent with those developed elsewhere. In Table B-2 below, we present some alternative estimates drawn from two previous studies.[11]

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[9] This result also implies that we should allow at least some labor income to be generated in our housing sector, especially on the paid rental side. However, we were frustrated in our attempt to find any statistical basis for this particular measurement.

[10] L. R. Christensen, and D. Cummings, "Real Product, Real Factor Input and Productivity in Canada", Social Systems Research Institute, University of Wisconsin, Discussion Paper No. 7532.

[11] CANDIDE model 1.1, Paper No. 18, Vol. 1, Economic Council of Canada, 1975, p. 190; A. D. Woodland, Factor Demand Functions for Canadian Industries, 1946-69, Research Branch, Department of Manpower and Immigration, Canada, 1972.

Table B-2

Alternative Estimates of Factor Shares

Sector	(1) Labor Share	(2) Labor Share
Forestry	.88	.86
Mining	.41	.42
Manufacturing	.67	.66
Construction	.84	.86
Transportation	.69	.71
Trade	.725	.76
Finance	.37	.39
Services	.84	.85

The first set of labor share estimates by the Economic Council are calculated from the geometric mean of the ratio of capital to labor income for the period 1953-1971. The second set, by Woodland, are econometrically estimated for the year 1961. Both sets of figures are quite close to our own estimates, except for finance and services. The alternative estimates indicate finance is somewhat less labor intensive (has a smaller labor share) than we have indicated in Table B-1, but we know that this particular sector is bedevilled by a number of measurement quirks. In the case of services, the alternative estimates refer to a comprehensive classification of both noncommercial and commercial activities and we might expect the latter category, by itself, to be less labor intensive than the aggregate bundle. All in all, we believe that the results of earlier research on factor shares strongly support the accuracy of our own methods. We use the factor share information contained in Table B-1, along with the industry weights shown in Table 3-1, to calculate the factor shares for final commodities that are displayed in Table 3-2.

Appendix C

Studies of Canadian Consumer Demand and Production Functions

Part I. Consumer Demand

Numerous attempts have been made to measure the important demand characteristics of particular commodities consumed in Canada. While they are of some interest, these individual studies of single markets do not permit satisfactory comparisons to be made for all of the various markets or commodities in the economy. Differences in econometric technique and specification, and also in time periods and measurement of the variables, serve to make the results of these studies largely noncomparable. A consistent measurement basis is found only in those studies which estimate the properties of a complete system of demand equations.

One of the few operational approaches to the estimation of complete systems is the linear expenditure system (LES) whose development is associated with the names of Stone and Geary.[1] The consumers' utility function underlying the LES is additively separable over all the objects of consumer choice, a simplification which greatly facilitates econometric estimation.[2] This formulation of the utility function can be algebraically represented as:

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[1] A rigorous discussion of the LES is found in Arthur S. Goldberger, "Functional Form and Utility: A Review of Consumer Demand Theory", Social Systems Research Institute Paper No. 6703, University of Wisconsin, 1967.

[2] Another virtue of this simplification is that it allows the explicit calculation of the elasticity of the marginal utility of income. This parameter is invariant to the utility scale that is chosen only under a linear monotonic transformation, a property which is preserved by the additivity assumption.

(1) $U = \sum_{i=1}^{n} B_i \ln (q_i - v_i)$; $0 < B_i < 1$; $\sum_{i=1}^{n} B_i = 1$; $v_i > 0$; $i = 1.....n.$

where U is total consumer utility, B_i and v_i are constants and q_i is the amount of the i'th commodity consumed. It may be noted that this specification is a monotonic transformation (the logarithm) of a Cobb-Douglas function in the arguments $(q_i - v_i)$. Maximization of this utility function, subject to a budget constraint $Y = \sum^{n} p_i q_i$, generates demand equations of the form:

(2) $p_i q_i = p_i v_i + B_i (Y - \sum^{n} p_i v_i)$, $i = 1 .....n.$

It is readily apparent from equation (2) that consumer expenditure is a linear function of all prices and consumer income Y. The intuitive explanation of these equations is that, given his income, the consumer buys minimum required amounts v_i of each good, which, in total, cost $\sum^{n} p_i v_i$, the subsistance income. With the excess, his "supernumerary income" of $(Y - \sum p_i v_i)$ the consumer acquires more of each good in the proportion B_i. Thus, the constants B_i are marginal budget shares giving the fraction in which incremental income is allocated. From the demand equations implicit in (2) above, it is easy to derive the price elasticity expressions shown in Chapter 3.

We are aware of four attempts to apply this theory of consumer demand to Canadian data. The results of these efforts, by Powell, McIntosh, Wales, and Goldberger and Gamaletsos, are shown in Table C-1. We show only their estimates of income elasticity since calculations of price elasticity are based directly on these figures. A few comments are in order at this point. First of all, the various studies do not employ a uniform commodity grouping, nor does the level of aggregation in any study

Table C-1

Estimates of Income Elasticity of Demand Using the LES

Commodity	(1)	(2)	(3)	(4)
Food	.58	.44	.75	.31
Tobacco and Alcohol	.79	-	-	
Clothing	.74	.51	.29	.33
Shelter	.51		-	
Rent	-		1.93	
Housing	-	1.3	-	1.14
Household Expenses	2.13			
Transport	2.32	1.42	1.26	
Recreation, Education and Entertainment	-	1.19		1.67
Personal and Medical Services	-	-		
Miscellaneous	.97	1.39	.92	

Sources

(1) Alan Powell, "Post-War Consumption in Canada: A First Look at the Aggregates", Canadian Journal of Economics and Political Science, Vol. 31, No. 4, November 1965.

(2) Curtis E. McIntosh, "Canadian Food Expenditures in 1980", Canadian Journal of Agricultural Economics, November 1974.

(3) Arthur S. Goldberger and Theodore Gamaletsos, "A Cross-Country Comparison of Consumer Expenditure Patterns", European Economic Review, Vol. 1, No. 3, 1971.

(4) Terence J. Wales, "A Generalized Linear Expenditure Model of the Demand for Nondurable Goods in Canada", The Canadian Journal of Economics, Vol. 4, No. 4, November 1971.

Note:

The various studies have adopted quite different commodity groupings, which in some cases are only approximately indicated by the brackets in the Table.

correspond exactly to that used in this study. Secondly, the time interval over which the estimation was conducted varies considerably. For these reasons, among others, the empirical results of different studies are not strictly comparable. However, despite considerable variation in the point estimates between different studies, a fairly consistent description emerges for the characteristics of the various commodities. Food goods are uniformly income-inelastic with an elasticity value that is probably less than one-half. Housing services, on the other hand, appear to be somewhat income-elastic with most values for the income elasticity slightly in excess of one.[3] Most of the items included in our corporate good category, clothing and footwear excepted, have an elasticity well in excess of one. Many of the studies encountered problems in measuring a reliable elasticity for services, in large part due to the shift in many health services to the public sector, but we know, with some certainty from other sources, that demand for this item is income-elastic.[4] Other studies applying the LES to United States data, and some which employ more flexible functional forms of additivity, reach similar conclusions.[5]

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[3] This is the conclusion of a recent study, I. C. R. Byatt, A. E. Holmans, and D. E. Laidler, "Income and the Demand for Housing: Some Evidence from Great Britain", in Essays in Modern Economics, M. Parkin and A. R. Nobay (eds.) (London: Longman Group, 1973). A value of unity is also suggested by L. B. Smith, The Postwar Canadian Housing and Residential Mortgage Markets and the Role of Government, (Toronto: University of Toronto Press, 1974).

[4] See, for example, E. R. Berndt, M. N. Darrough and W. E. Diewert, "Flexible Functional Forms and Expenditure Distributions: An Application to Canadian Consumer Demand Functions", University of British Columbia Discussion Paper No. 76-06. Using a threefold division of commodities, nondurables, durables and services, and three general functional forms which permit additivity as a special case, the authors conclude that demand for services is income-elastic, demand for durables is approximately unitary income-elastic, while the demand for nondurables is decidedly income-inelastic.

It might be asked how the previous estimates compare when stood alongside others which do not adopt the additivity assumption. The answer seems to be very well indeed. In Table C-2 we present the results of two studies on Canadian expenditure elasticities, one of them estimated on a cross-section basis and the other on a time-series basis.[6] The cross-section estimates, which are derived from the Family Expenditure Survey for 1969 and which hold family size constant, utilize a double-log specification and generally yield values which are smaller than those of the time-series estimates.[7] This result is not too

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[5] Two recent examples of U.S. applications are Louis Phlips, "A Dynamic Version of the Linear Expenditure Model", The Review of Economics and Statistics, Vol. 54, No. 4, 1972, and C. Lluch and R. Williams, "Consumer Demand Systems and Aggregate Consumption in the U.S.A.: An Application of the Extended Linear Expenditure System", The Canadian Journal of Economics, Vol. 8, No. 1, February 1975. Some studies have compared the LES with more flexible variants of it, in particular, the generalized linear expenditure system (GLES) and the indirect addilog expenditure system. The former makes marginal budget shares a function of prices, while the latter allows these shares to be influenced by income levels as well as prices. In his comparison of alternative forms, Theodore Gamaletsos, "Further Analysis of Cross-Country Comparisons of Consumer Expenditure Patterns", European Economic Review, Vol. 4, 1973, finds that the difference between the LES estimates and those of the less restrictive variants is insignificant. Wales, op. cit., comes to the same conclusion in his study.

[6] As a matter of definition, the income elasticity of demand equals the expenditure elasticity times the income elasticity of total expenditure. If the latter is unity, as with the permanent income theory of consumption, income and expenditure elasticities are equal.

[7] The time-series estimates are based on an application of the dynamic Houthakker-Taylor model to Canadian data. See H. Houthakker and L. Taylor, Consumer Demand in the United States, 1929-70: Analyses and Projections. (Cambridge: Harvard University Press, 1966).

Table C-2

Estimates of Canadian Expenditure Elasticities

Commodity	(1)	(2)
Total Food	.46	.48
Food at Home	.29	-
Shelter	.83	1.26
Household Expenses	.96	1.31
Furnishings and Equipment	1.16	1.47
Clothing	.96	.75
Personal Care	.92	1.82
Medical and Health Care	.64	1.65
Smoking and Alcoholic Beverages	.92	.85
Travel and Transport	1.21	1.8
Recreation, Reading, Education and Miscellaneous	1.3	1.4

Sources

(1) Zuhair A. Hassan, "Household Expenditure Patterns in Canada", Canadian Journal of Agricultural Economics, Vol. 22, No. 2, July 1974.

(2) T. Schweitzer, Personal Consumer Expenditures in Canada, 1926-75. Economic Council of Canada, Staff Study No. 26, December 1969, See also, T. Schweitzer, Sector B: Disaggregated Consumption in CANDIDE, Model 1.1, Paper No. 18, Vol. 1, Economic Council of Canada, 1975.

surprising if, at any particular time, people's budgets have not fully adjusted to previous income changes. The largest discrepancy is in the estimates for services (personal, medical and health care, plus some components of household operation) which are income-inelastic (elastic) in the cross-section (time-series) formulation. We believe that the time-series information is more appropriate in this particular case since our model analyzes adjustments which occur over an extended period of time.

Like the previous LES estimates, the expenditures elasticities indicate that food is income-inelastic, housing services may be slightly greater than unit-elastic, while services and the items in our corporate goods category are, beyond much doubt, income-elastic. As consensus estimates based on the available evidence, we adopt income elasticities of .4, 1.1 and 1.2 for food, housing and commercial services, respectively. Since saving, or expenditure, on investment goods is an approximately constant fraction of income over time, we take this component of corporate goods to have an income elasticity of one. If corporate consumption goods have an income elasticity of 1.18, the expenditure share-weighted income elasticity of both types of corporate good is 1.1.[8] Using the budget shares given in Table 3-10, we impose the Engel aggregation requirement to derive the income elasticity of imports as .84, as shown in Chapter 3.[9]

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[8] If an aggregate is the sum of two components, the income elasticity of the aggregate is a weighted average of the elasticities of the components, with the weights representing the fraction of each component in the total.

[9] It may be noted that neither of the studies cited in Table C-2 use a demand specification which automatically satisfies this requirement.

In the case of urban transit, a recent survey of much of the relevant literature concludes that a price elasticity of -.3 is warranted on the basis of past econometric effort, although values as high as -.6 have been obtained for West Germany.[10] Within the framework of our additive utility model of consumer demand, this is consistent with an income elasticity of -.46, if the elasticity of the marginal utility of income is -1.55. Values of this magnitude are also in agreement with the data contained in the Family Expenditure Survey for 1969. For about a fivefold increase in family income, expenditures on urban transit increase by a factor of 2 to 2.5, which suggests an arc income elasticity in the neighborhood of .4 - .5.[11]

Part II. Production Functions

Far less empirical work has been done on the ease of factor substitution in Canadian industries than on their final demand characteristics.[12] While estimates are available for the elasticity of factor substitution between capital and labor in some Canadian industries, for the most part we have had to rely on studies which either deal with other countries or which resort to the use of international cross-section data. Most of the Canadian studies have focused exclusively on the manufacturing sector where the data base is most amenable to research. One study by Kotowitz, which employed a CES (constant elasticity of substitution) production function, indicated that the elasticity for manufacturing was in the range .3 to .5.[13] A subsequent study by Tsurumi was unable to refute the hypothesis that the manufacturing elasticity equalled one.[14] We therefore experiment with a value of .5 to one for this industry. An attempt to estimate elasticities for all Canadian one-digit industries has been made by Woodland.[15] Although he distinguishes various types of capital goods in his model, we present only his elasticity estimates for aggregate capital-labor substitution in Table C-3 below:

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[10] Herbert J. Baum, "Free Public Transport", Journal of Transport Economics and Policy, Vol. 7, No. 1, January 1973, p. 5.

[11] See Mark Frankena, "Income Distributional Effects of Urban Transit Subsidies", Journal of Transport Economics and Policy, Vol. 7, No. 3, September 1973, p. 226.

[12] Even the sophisticated CANDIDE model of the Economic Council of Canada relies on the simple assumption that all industries operate with a Cobb-Douglas technology in which the elasticity of factor substitution is unity.

Table C-3

Estimates of Capital-Labor Substitution Elasticities

Industry	σ_{KL}
Agriculture	.48
Forestry	.13
Fishing	.34
Mining	.79
Manufacturing	.39
Construction	.98
Transportation	.05
Trade	.06
Finance	.33
Services	.28

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[13] Yehuda Kotowitz, "Capital-Labor Substitution in Canadian Manufacturing, 1926-39 and 1946-61", The Canadian Journal of Economics, Vol. 1, No. 3, August 1968.

[14] Hiroki Tsurumi, "Nonlinear Two-Stage Least Squares Estimation of CES Production Functions Applied to the Canadian Manufacturing Industries, 1926-39 and 1946-67", The Review of Economics and Statistics, Vol. 52, No. 2, May 1970.

[15] A. D. Woodland, Factor Demand Functions for Canadian Industries, 1946-69, Department of Manpower and Immigration, Canada, 1972.

Although Woodland's estimates strike us as being plausible indications of the relative ease of factor substitution in different industries, they are, on the whole, of lower absolute value than those obtained in other studies. There is some empirical evidence that, in the case of agriculture, mining and construction, the elasticity of substitution between capital and labor may be larger than one. Thirsk, for example, has recently reviewed some empirical work which employs a three-factor production model in agriculture, and concludes that the available evidence argues for an elasticity value somewhere between one and one and a half.[16] Evidence from a survey by Nerlove suggests that the same range may be applicable for mining.[17] Moreover, a recent examination of the construction sector suggests that there may be ample opportunity for factor substitution in this activity.[18] Thus, for these three sectors we experiment with elasticity values in the range of 1 to 1.5.

For the trade, transport, finance, and services sectors, there is some skimpy evidence which indicates that the possibilities for factor substitution are limited, although not quite as constrained as the low elasticity values obtained by Woodland would imply.[19] For the trade sectors we use a range of .8 - 1 and a slightly lower range for finance, .5 - .8. For personal services and the transport-communications sector, we employ the relatively low ranges of .2 - .4 and .1 - .3, respectively.[20] We have no direct information on the housing and forestry sectors but would expect the latter activity's high degree of labor intensity to be consistent with a fairly low substitution elasticity. Since labor is an unimportant factor in the production of housing services, we anticipate that most of the latitude for factor substitution in this sector is confined to a choice between capital and land. As our measurement for the case of substitution between these two factors, we assume an elasticity range of .5 to 1, while for capital and labor, and land and labor, we assume an extremely low elasticity range of zero to .1.[21] We also have no direct evidence to summon in the case of urban transit and local government services. We do know, however, that these are highly labor intensive activities which suggests that the elasticity of capital-labor substitution does not exceed unity.[22] We, therefore, operate with an elasticity range of .5 - 1 for urban transit and take unity as the appropriate value for local government services. Since we weight each sectoral elasticity by the proportion of value-added that each sector contributes to the production of final output, most of our capital-labor elasticity ranges for final goods fall in the traditional interval bounded by values slightly less than one and values somewhat larger than one. The only exceptions are activities of a service nature which are either highly capital intensive (e.g., housing) or labor intensive (e.g., personal services). In addition, our weighting procedure serves to minimize the impact of any significant error in the measurement of a particular elasticity value.

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[16] Wayne R. Thirsk, "Factor Substitution in Colombian Agriculture", American Journal of Agricultural Economics, Vol. 56, No. 1, February 1974.

[17] Marc Nerlove, "Recent Empirical Studies of the CES and Related Production Functions", in The Theory and Empirical Analysis of Production, edited by Murray Brown, National Bureau of Economic Research, 1967.

[18] W. Paul Strassman, "The Construction Sector in Economic Development", Scottish Journal of Political Economy, Vol. 17, November 1970. A range of values between .9 and 1.5 is reported in G. Araud, G. Boon, V. Urquidi, and P. Strassman, Studies on Employment in the Mexican Housing Industry, OECD Employment Series No. 10, Paris, 1973.

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[19] See Kenneth Arrow, Hollis B. Chenery, Bagicha S. Minhas and Robert M. Solow, "Capital-Labor Substitution and Economic Efficiency", The Review of Economics and Statistics, Vol. 43, No. 3, August 1961.

[20] Except for transport and communications, our elasticity ranges are in rough agreement with the "best" estimates used by Whalley in his study of tax changes in the U.K. See John Whalley, "How Reliable is Partial Equilibrium Analysis?", The Review of Economics and Statistics, Vol. 75, No. 3, August 1975.

[21] Muth, for example, argues that the elasticity of substitution of land for other inputs is of the order of .75. See Richard F. Muth, "The Derived Demand Curve for a Productive Factor and the Industry Supply Curve", Oxford Economic Papers, Vol. 16, No. 2, 1964. In a later study, Muth suggests that the elasticity of real estate (land plus structures) for current inputs is about .2. See Richard F. Muth, "Capital and Current Expenditures in the Production of Housing", Chapter 4 in Government Spending and Land Values: Public Money and Private Gain, C. Harriss, Lowell (ed.), University of Wisconsin Press, 1973. Similar values for these elasticities are also reported in Richard F. Muth, "The Derived Demand for Urban Residential Land", Urban Studies, Vol. 8, No. 3, October 1971, and by Roger Koenker, "An Empirical Note on the Elasticity of Substitution between Land and Capital in a Monocentric Housing Market", Journal of Regional Science, Vol. 12, No. 2, August 1972.

We conclude this appendix with a brief discussion of the appropriateness of our aggregation procedure, since it may not be entirely obvious that, under certain assumptions, our method is correct. Consider an output which combines only two activities, S and Y, such that $K = K_X + K_Y$ and $L = L_X + L_Y$. The aggregate substitution elasticity between capital and labor is defined as:

$$\sigma = (\hat{K} - \hat{L})/(\hat{P}_L - \hat{P}_K) = \hat{K}_X \left(\frac{K_X}{K}\right) + \hat{K}_Y \left(\frac{K_Y}{K}\right) - \hat{L}_X \left(\frac{L_X}{L}\right) - \hat{L}_Y \left(\frac{L_Y}{L}\right)/(\hat{P}_L - \hat{P}_K).$$

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[22] Mohring claims that bus driver costs account for about 70 per cent of total transit system cost. See Herbert Mohring, "Optimization and Scale Economies in Urban Bus Transportation", American Economic Review, Vol. 62, No. 3, December 1972. Studies of European systems give a range of 70 to 75 per cent. See Baum, op. cit., p. 13 and Stewart Wabe and Oliver B. Coles, "The Short and Long-Run Cost of Bus Transport in Urban Areas", Journal of Transport Economics and Policy, Vol. 9, No. 2, May 1975.

From elementary production theory, we know that:

$\hat{K}_X = \theta_{LX} \sigma_X (\hat{P}_L - \hat{P}_K)$ and $\hat{L}_X = - \theta_{KX} \sigma_X (\hat{P}_L - \hat{P}_K)$.

Substituting these equations and a similar set for activity Y, into the previous equation gives us the result:

$$\sigma = \theta_{LX} \sigma_X (\frac{K_X}{K}) + \sigma_{LY} \sigma_Y (\frac{K_Y}{K}) + \theta_{KX} \sigma_X (\frac{L_X}{L}) + \theta_{KY} \sigma_Y (\frac{L_Y}{L}).$$

Without further assumptions, it is not possible to go beyond, or simplify, the preceding expression. However, if we assume that, at any configuration of relative factor prices, each activity in the aggregate has the same capital-labor ratio, then it follows that $K_X / K = L_X / L$ and $L_Y / L = K_Y / K$. Making these substitutions in the expression for the aggregate elasticity, we have $\sigma = \frac{K_X}{K} \sigma_X + \frac{K_Y}{K} \sigma_Y$.

By the assumption of constant returns to scale, we can replace the capital share weights with the value-added weights of each activity in the aggregate.[23] As is usually the case, the conditions for consistent aggregation are fairly stringent and require that each activity contained in the aggregate has approximately the same production function. Ordinarily, we would not expect this condition to be fulfilled. However, the large range of substitution values that are entertained for any aggregate activity will absorb any error that is introduced by the need to adopt a workable method of aggregation. Only if our empirical knowledge were improved and more confidence could be placed in point estimates of the substitution parameters, would it become desirable to achieve greater accuracy in the aggregation procedure.

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[23] For a CES production function, the relationship between factor proportions and factor prices can be written, in the two-factor case, as $P_L/P_K = (1 - S) / S \ (K/L)^{1/\sigma}$.
Thus, if for any given configuration of relative factor prices, each component of an aggregate is to have the same factor employment ratio, the distribution parameter, S, must take on values that are consistent with, and correspond to, the value of the substitution elasticity. Alternatively, use of a simple aggregation procedure and data on factor payments implies a particular choice of the substitution parameter.

Given the wide range of values considered for the substitution parameter in each aggregate activity, it is highly unlikely that this aggregation error has any important bearing on our results. Another minor inconsistency can be found in the treatment of the three-factor production functions for housing and agriculture. From the earlier discussion in Chapter 2, primary and intermediate inputs are separable in production, if all of the partial substitution elasticities between these two types of input are equal. This requirement is not easily reconciled with the variable elasticity of production function which underlies our choice of values for the three-factor cases.

Appendix D

Construction of Data for Provincial Revenue-Sharing Experiments

Although the system of national accounts is extremely detailed and provides an abundance of information on the economy, it has no counterpart at the provincial or regional level. Some provincial governments, most notably Ontario, have attempted to establish a system of provincial accounts for their own area, but for most provincial jurisdictions there is both a dearth of relevant data and an apparent lack of enthusiasm in mounting efforts to develop this information.[1]

As a result of this factual void, an attempt was made to construct some rough estimates of the essential accounting relationships that were required for the operation of the interregional model. The procedure used consisted of working backwards from observed consumption data to an implied structure of production that would be compatible with the demand data. Thus, we began with the expenditure data shown in Table 3-14 in the text and imposed some "reasonable" assumptions about the nature of interregional and international trade on this data, also shown in Table 3-14. In that table, consumer expenditure data were supplemented with information on regional investment spending which was assumed to be met entirely from regional sources of supply. Assuming that indirect tax rates were uniform across regions, it was possible to divide expenditures on each commodity into value-added and indirect tax components. Value-added was subsequently divided into factor payments to labor, capital and land, using the national coefficients for these shares given in Table 3-2. Subtracting capital taxes from total value-added, again using national coefficients for the rates applied to each commodity, adding transfer payments and deducting personal income taxes, as well as payments to foreign capitalists, provided estimates of total disposable income which was distributed among different income groups using provincial data on labor incomes by income class. Expenditure of this income on the various commodities was assumed to adhere to the national consumption patterns shown in Table 3-9. Finally, the government's budget statement was broken up into two separate statements, one for the federal government and the other for the consolidated provincial-municipal budget.

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[1] Since this appendix was written, Statistics Canada has published a new series entitled System of National Accounts - Experimental Data Provincial Economic Accounts, No. 13-213, for the period 1961-1966, which is an important effort to fill this vacuum.

Although this general procedure was applied to each of the provinces appearing in Table 3-15, we shall illustrate the techniques that were followed by developing the case for British Columbia. B.C., it will be recalled, was one of the provinces for which the results of the inter-regional model were reported in Chapter 6. National expenditures on commodities C, A, H, Z and W, inclusive of indirect taxes, were estimated, in millions, to be \$17,060, \$6,254, \$7,102, \$8,486, and \$11,918, respectively. In B.C., it is estimated, for example, that expenditures on A were \$641 mn. (Table 3-14), while labor income generated in the national production of A was \$3,286 mn. (Table 3-4). Thus, we estimate that \$337 mn. was paid to labor employed in producing A in the province of B.C. (337 = 641/6254 (3,286)). A similar calculation gives rise to estimates of B.C.'s gross capital income, corporate income and property taxes paid, and, where applicable, land income that derives from the production of A. For investment expenditures (W), it appears that around 12.7 per cent of total capital expenditures was carried out in B.C. in 1960.[2] Taking 12.7 per cent of total labor and capital income generated in the national production of W gives an estimate of value-added produced in B.C., one which assumes that there are no imports of W either from the rest of Canada or from the rest of the world. To this estimate is added a sum for indirect tax paid (based on the national tax rate) and the total of these two items represents final expenditures on this commodity. The difference between total value-added and the value of purchases represents indirect taxes paid in each private activity. All of these functional income calculations for B.C. are brought together in Table D-1. The conversion from a functional to a size distribution of income is shown in Table D-2 for the threefold income group classification that was used in operating the model. Labor income was distributed among income groups according to the provincial income series presented by Maslove.[3] This was one of the few instances in which acknowledged provincial diversity could be allowed to affect the process of constructing the data. After-tax capital income, by way of contrast, was distributed according to the national pattern of capital ownership shown in Table 3-7. Payments to foreign capitalists, assumed to be 7 per cent of the national total or $76 mn., have also been netted out of this figure. There was no basis on which to make some allowance for payments to capitalists residing in

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[2] See the Statistics Canada bulletin No. 61-205, Private and Public Investment in Canada, Outlook 1969.

[3] Allan M. Maslove, op. cit., pp. 166-67.

Table D-1

Functional Income Distribution for British Columbia

Value of: (millions)	A	C	H	W	Z	E	G	M	Total
Purchases	641	2026	728	1610	540	1631	--	483	--
Indirect Taxes	60	239	69	148	97	178	--	20	811
Value-added	581	715	659	1462	443	1453	1089	--	6402
Labor Income	337	486	75.4	1038	319.4	908	1089	--	4253
Gross Capital Income	244	229	584	424	124	545	--	--	2150
Corporate Income Taxes	24.4	41.4	5.3	91.3	16.3	108	--	--	286.7
Property Taxes	28	16.2	171.4	23.7	9.4	29	--	--	277.7
Total Taxes on Capital	52.4	57.6	175.7	115	25.7	137	--	--	563.4

other provinces, and so no adjustment was made on this score. If, from the sum of net capital income and labor income, total transfers are added and personal income taxes subtracted, the result is an estimate of disposable income of $5,747 mn. The distribution of transfers and personal income taxes among income classes relies once more on Maslove's provincial series for these items.

The treatment of the public sector totals for government expenditure, personal income taxes and transfers, requires some further explanation. According to the national accounts, the federal government was responsible for 30 per cent of exhaustive expenditure in 1969, or about $4,240 mn., if total government expenditure on goods and services is $14,136 mn., as reported earlier. Since total municipal expenditure is taken to be $6,712 mn. (Table 3-14), the residual amount, $3,184 mn. is attributable to the spending by all provincial governments. On the basis of information pertaining to the cost of public services provided, it seems that B.C.'s share of provincial spending is about 10 per cent, suggesting that $318 mn. was the amount spent by that jurisdiction in 1960.[4] Similarly, it appears that about 8 per cent of federal spending (or $343 mn.) takes place in B.C. If 80 per cent of the combined expenditures of both levels of government constitutes payments to labor, $529 mn. is this portion of the government payroll in B.C. Applying the same percentage to total municipal expenditures of $700 mn. (Table 3-14) and adding this estimated payroll figure to the previous one, gives an estimate of $1,089 mn. as the total labor income attributable to the activities of the public sector in B.C. It is this figure which appears in

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[4] See Table 7, Provincial Government Finance, Statistics Canada, No. 68-205.

Table D-2

a) Size Distribution of Income for British Columbia

Income Group	Labor Income	After-Tax Capital Income	Transfer Payments (millions)	Personal Income Taxes	Disposable Income	Total Consumption	Saving
Low	144	128	507	21	758	535	223
Middle	1870	583	332	360	2425	1997	428
High	2218	800	176	630	2504	1886	678
TOTAL	4232	1511	1015	1011	5747	4419	1328

b) Expenditure Patterns for British Columbia - (millions)

Income Group	A	C	H	Z	M	TOTAL
Low	108	408	109	63	68	758
Middle	313	1327	355	228	222	2425
High	219	1619	284	251	193	2564
TOTAL	640	3355	728	542	483	5747

c) Private and Public Budget Constraints for British Columbia

Sector	M	Expenditures On: (millions) L	Expenditures On: (millions) CAHZ	W		Income
Public	--	1089	--	282	=	1371
Private	483	--	3935	1328	=	5746
TOTAL	483	1089	3935	1610		$7117

Table D-1 under the heading of labor income for the public sector denoted as G. On the revenue side, Maslove's data indicate that residents of the province of B.C. pay 11.6 per cent of all personal income taxes and receive about 12 per cent of all transfer payments made through the fisc.[5] Since, in the model, personal income taxes amount to $8,717 mn., in total, while national transfers are $8,452 mn., these percentages translate into values for B.C. of $1,011 mn. of personal income taxes paid, and $1,015 mn. in transfer payments received.

Two more adjustments are necessary to close the system and ensure that the set of numbers depicts a consistent macroeconomic equilibrium. The residual or balancing item in the preceding calculations is investment spending, W. Until now, no effort has been undertaken to guarantee that total savings will match expenditures on investment goods (a component of corporate output in our model). As shown in Table D-2, private saving, including imputed depreciation, is $1,328 mn., an amount less than investment by $282 mn. This shortfall in private saving must be balanced by additional public sector saving of the same amount if the demand for investment goods is to match their supply. All levels of governments combined are required to run a revenue surplus of $282 mn. This "expenditure" requirement is reflected in the public sector budget constraint shown in Table D-2 where it is also assumed, for the sake of simplicity, that governments purchase neither imports nor domestically produced output besides W. Addition of private and public sector incomes provides a measurement of gross national provincial product (GNPP) of $7,117 mn. Gross domestic provincial product (GDPP), the sum of all values-added plus indirect taxes, is $7,193 mn.[6] The gap between GDPP and GNPP is $76 mn., the amount of income produced in the provincial economy that is assumed to be paid to non-Canadians. Moreover, this economy is in balance of payments equilibrium: export revenues of $1,631 mn. pay for the sum of imports from the rest of Canada ($1,072 mn.) and from the rest of the world ($483 mn.) and, as well, the incomes earned by foreign capitalists ($76 mn.).

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[5] Allan M. Maslove, op. cit., pp. 18-19 and pp. 48-49.

All that remains to be done now is to partition the public sector budget into its provincial-municipal and federal contributions. The overall budget constraint states that expenditures of $1,089 mn. on public services (G), transfers of $1,015 mn., and expenditures on investment goods of $282 mn., are financed by $1,011 mn. of personal income taxes, $286 mn. of corporate income taxes, $278 mn. of property taxes, and $811 of indirect taxes. The national accounts indicate that about 41 per cent of all public transfer payments originate in the provincial-municipal sector. Similarly, Maslove's study suggests that the provincial government collected about 22 per cent of individual income taxes, one-quarter of all corporate income taxes, while all of the property taxes and about 55 per cent of the indirect taxes are directed towards the coffers of sub-federal governments. The difference between total expenditures at the provincial-municipal level and revenues from the various sources is $209 mn., an amount which, it is assumed, represents the federal contribution to the budgets of the provincial and municipal governments.[7] Thus, the various elements in the public sector budgets and their size can be seen by examining Table D-3 below.

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[6] A GDPP value of $8,889.7 mn. is reported in the Provincial Economic Accounts for 1969 but this figure encompasses the Yukon and Northwest Territories as well as the province of B.C.

Table D-3

Federal and Sub-Federal Government Budgets in British Columbia

	EXPENDITURES ON:				REVENUES FROM:				
Government	G	Transfers	Investment (W) (millions)		Personal Income Taxes	Corporate Income Taxes	Property Taxes	Indirect Taxes	Federal Transfers
Provincial-Municipal	814	416	--	=	226	71	278	446	209
Federal	275	599	282	=	785	215	--	365	-209

Note that the assumption regarding the division of spending on investment goods is entirely arbitrary. If the provincial-municipal government bought some output of W too, it would have to receive a larger transfer from the federal government than is shown in the table above.

The region referred to as the rest of Canada in the provincial revenue-sharing experiments is defined by subtracting the appropriate provincial figures, such as those found in Table D-1 to D-3 for British Columbia, from the national estimates that appear in Tables 3-5 and 3-8 in the text. In the case of Ontario, an analogous procedure was used to develop the data presented in Tables D-4 and D-5. Behind these estimates for Ontario lie the assumptions that that province pays 44.6 per cent of all personal income taxes and receives 32 per cent of all public transfers, that payments to foreign (non-Canadian) capitalists were $541 mn. and that the activities of the public sector result in payments to labor of $960 mn. by the provincial government, $1,320 mn. by the federal government, and $2,329 by municipal governments. All of the previous assumptions concerning the regional uniformity of the national tax and production coefficients continue to apply in this case as well. GNPP is estimated to be $28,044 mn., compared to $28,585 mn. for GDPP, the discrepancy once again reflecting the existence of payments to residents outside the country.[8] The external payments position is in balance with exports of E and F, worth a joint value of $6,800 mn., just offsetting imports valued at $6,259 mn. and foreign capital payments of $541 mn.

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[7] In the national accounts, government spending at any level excludes transfers to lower level governments in order to avoid double counting. In the public finance statistics, however, transfers are included in the expenditure of the contributing rather than the receiving government.

The decomposition of the public sector budget into its jurisdictional components is shown in Table D-6.

There are several ways to check the accuracy of at least some of the estimates contained in Tables D-1 to D-6. Table D-7 presents a comparison between national accounts data and our constructed data for some of the items that each series has in common with the other. Labor income appears to be slightly underestimated in both provinces by about 8-9 per cent.

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[8] In the Provincial Economic Accounts for 1969, Ontario is recorded as having a value of $34,067.8 mn. for GDPP. Our value is 16 per cent smaller than this amount.

Table D-4

Functional Income Distribution for Ontario

Value of: (millions)	A	C	H	W	Z	E	F	G	M	TOTAL
Purchases	2557	4450	2900	5089	2180	4212	788	--	6259	
Indirect Taxes	276	1107	288	400	393	435	82	--	361	3342
Value-added	2281	5143	2612	4328	1787	3777	706	4609	--	25243
Labor Income	1344	3497	299	3073	1287	2360	343	4609	--	16812
Gross Capital Income	937	1646	2313	1255	500	1417	363	--	--	8431
Corporate Income Taxes	97	297	21	270	67	282	12	--	--	1046
Property Taxes	112	116	679	70	38	74	48	--	--	1137
Total Taxes on Capital	209	413	700	340	105	356	60	--	--	2183

Table D-5

a) Size Distribution of Income for Ontario

Income Group	Labor Income	After-Tax Capital Income	Transfer Payments (millions)	Personal Income Taxes	Disposable Income	Total Consumption	Saving
Low	406	511	1166	54	2029	1689	340
Middle	6304	2198	1005	1096	8411	7408	1003
High	10,102	2998	533	2738	10,895	9249	1646
TOTAL	16,812	5707	2704	3888	21,335	18,346	2989

b) Expenditure Patterns for Ontario - (millions)

Income Group	A	C	H	Z	M	TOTAL
Low	340	607	346	190	546	2029
Middle	1171	2749	1208	805	2478	8411
High	1046	4083	1347	1185	3234	10,895
TOTAL	2557	7439	2901	2180	6258	21,335

c) Private and Public Budget Constraints for Ontario

Sector	M	Expenditures On: (millions) L	CAHZ	W		Income
Public	--	4609	--	2100	=	6709
Private	6259	--	12,087	2989	=	21,335
	6259	4609	12,087	5089		28,044

Table D-6

Federal and Sub-Federal Government Budgets in Ontario

	EXPENDITURES ON:					REVENUES FROM:								
Government \	G		Transfers	Investment (W) (millions)		Personal Income Taxes		Corporate Income Taxes		Property Taxes		Indirect Taxes		Federal Transfers
Provincial-Municipal	3289	+	1108	--	=	875	+	262	+	1137	+	1671	+	452
Federal	1320	+	1596	2100	=	3013	+	764	+	--	+	1671	-	452

Table D-7

A Comparison of the Constructed (1) and National Accounts Data (2)

Province	Labor Income (1) (millions)	Labor Income (2)	Estimate of Disposable Income (1) (millions)	Estimate of Disposable Income (2)	Provincial-Municipal Government Spending (1) (millions)	Provincial-Municipal Government Spending (2)	Property Taxes (1)	Property Taxes (2)
British Columbia	$ 4,232	$ 4,606	$ 5,747	$ 5,414	$ 1,230	$ 1,521	1,137	1,239
Ontario	$16,812	$18,447	$21,335	$20,696	$ 5,468	$ 5,826	278	315

Note: For the first two comparisons, the alternative estimates are drawn from System of National Accounts. National Income and Expenditure Accounts. Vol. 1, The Annual Estimates, 1926-1974. Statistics Canada, No. 13-531, while the last two comparisons rely on data from Consolidated Government Finance - Revenue and Expenditures and Assets and Liabilities of Federal, Provincial and Local Governments, Statistics Canada, No. 68-202, Tables 4 and 5.

Disposable income, on the other hand, is slightly overestimated, but this is to be expected since our method imputes income flows to households that are excluded from the National Accounts concept. In addition, consolidated provincial-municipal spending and property taxes also seem to be less than their "true" values but the degree of understatement is relatively small in both cases. We conclude, on the basis of these comparisons, that our procedures allow a reasonable degree of confidence to be attached to the accuracy of our estimates.

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